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Original Articles

GENERAL GROWTH ACCELERATION AND RETARDATION IN RELATION TO DENTOFACIAL DEVELOPMENT

J. A. Salzmann, D.D.S., F.A.P.H.A.,* New York, N. Y.

INTRODUCTION

At THE 1950 White House Conference on Children and Youth[1] in which orthodontics, along with all disciplines dealing with child health, welfare, and education was represented, there was one dictum on which all agreed: *to handle children successfully, one must "know the child."*

As practitioners of orthodontics, our attention must be centered on the child as a whole, and not merely on the malformation which we undertake to treat. We now realize that we are dealing with more than a local somatic problem of a biophysical nature, which merely requires the application of mechanical force to bring about desired changes in the dentofacial area. We realize also that there are psychic involvements which can be responsible for certain somatic changes, as, for example, when the patient practices pressure habits which affect dentofacial development. We know that growth, development, and function, whether normal or abnormal, are always factors in orthodontic therapy. We realize also that there are aberrations of physical growth and development of genetic, prenatal, postnatal, local, and systemic origin which must be taken into account if successful terminal results of treatment are to be obtained.

While orthodontists have been giving due consideration to growth standards in children when establishing a diagnosis and planning treatment, they have not always given sufficient weight to systemic involvements affecting growth and development in the individual child.

Presented before the American Association of Orthodontists, Dallas, Texas, April 28, 1953.
*Associate Attending Dentist, Chief of Orthodontics and Director of the Cleft Palate Center, The Mount Sinai Hospital, New York City.

CASE ANALYSIS RECORD
MT. SINAI HOSPITAL ORTHODONTIC CLINIC, RESEARCH DEPARTMENT

CASE NO. DATE
CLINIC NO. AGE
NAME
ADDRESS SEX
SIBLINGS

MEDICAL DIAGNOSIS 1.
2.
3.
BONE-AGE (WRIST)

DENTAL EXAM: TEETH PRESENT R | L
MAXILLA
MANDIBLE
DENTAL AGE
OCCLUSION
DECIDUOUS ERUPTION (FIRST TOOTH)
PERMANENT ERUPTION (FIRST TOOTH)
CARIES INCIDENCE (DMF)
PERIODONTAL CONDITION
ORAL HABITS
ORO-FACIAL MUSCULATURE
FRENUM ; TONGUE
PREMATURE EXTRACTIONS OF DECIDUOUS OR PERMANENT TEETH
DENTAL ANOMALIES
ROENTGEN FINDINGS:
INTRA-ORAL
LATERAL-JAW
PROFILE
CASTS
PHOTOS

Fig. 1.

MEDICAL HISTORY

MOTHER'S PRENATAL CONDITION WEIGHT AT BIRTH
DELIVERY
CONGENITAL DEFECTS
HEALTH AS INFANT
BREAST OR BOTTLE FED
AGE BEGAN TO WALK
AGE BEGAN TO TALK
CONTAGIOUS DISEASE --
SERIOUS ILLNESSES --
ALLERGIC HISTORY --
NUTRITIONAL AND GASTRO-INTESTINAL HISTORY ------------------------------
ENDOCRINE HISTORY --
OPERATIONS AND ACCIDENTS --
HEREDITARY TENDENCIES --
BLOOD CHEMISTRY --
PRESENT HEALTH HEIGHT -------------------- WEIGHT --------------------
NORMAL HEIGHT -------------------- WEIGHT --------------------
SPECIAL NOTATION --

Fig. 2.

The purpose of this article is to present the need, scope, methods, and a sampling of the material used, in a study which I am now conducting at The Mount Sinai Hospital in New York City, to obtain information on the influence of systemic disturbances on dentofacial growth and development. The information published on the subject in the past is frequently contradictory, inadequate, and at times appears also inaccurate in the light of present knowledge.

CHARACTERISTICS OF GROWTH AND DEVELOPMENT

Growth in infancy is more rapid than in any other period of postnatal life. A change in weight from approximately 3.3 to 10 kg. takes place in one year of early infancy. The same percentage increase in weight, from 10 to 30 kg., requires seven additional years. During the first year of life, body weight increases 200 per cent, while in the next seven years the increase is 28 per cent annually.[2] It may be seen, therefore, that while absolute growth is small in early infancy, it is proportionately huge in comparison to that of later years. Disease and functional disturbances in infancy and early childhood may interfere with growth and development. Such interferences may or may not be successfully overcome during later childhood and adolescence.[3]

Ontogenetic growth and development follow a phylogenetic pattern and are under the influence of genetic endowment which evidences itself in constitutional differences. Postnatal and terminal growth especially are under the influence of environment. Growth may be divided into *somatogenetic* and *morphogenetic* categories.[4] Somatogenetic growth refers to growth in volume of the soft tissues and is controlled by the so-called target glands: the thyroid, adrenals, and gonads. Morphogenetic growth refers to growth of the skeletal structures and is controlled by the anterior lobe of the pituitary or hypophysis.

Necessary for normal growth are an adequate supply of amino acids, vitamins, minerals, and oxygen. Deficiencies of the foregoing growth elements, the presence of disease, and hormonal disbalance especially of the anterior lobe of the hypophysis or pituitary, the thyroid, the adrenals, and the gonads can interfere with general (including dentofacial) growth and development.[5]

CRITERIA FOR ASSESSING STATUS AND PROGRESS OF GROWTH AND DEVELOPMENT

The following criteria for assessing the status and progress of growth and development are of special importance in the practice of orthodontics.

1. Height and weight.
2. Bone age.
3. Dental age.
4. Skeletal proportions.
5. Craniofacial contours.
6. Facial features.
7. Endocrine balance.

1. *Height and Weight* measurements are taken of the patient and compared to standards of height and weight according to sex and chronological age.[6]

Wetzel's grid[7] provides a method of using height and weight and chronological age to determine developmental progress in an individual over a given period of time. The use of Wetzel's grid[8] provides a method by which height and weight are employed as clues to physical growth and maturation (Fig. 3).

2. *Bone Age* is an indication of the maturative growth and physical development of the child and is determined by the time scale of appearance and progress of ossification as shown on roentgenograms of certain bones as in the hand, the carpals of the wrist, elbow, shoulder, hip, knee, and the foot.[9]

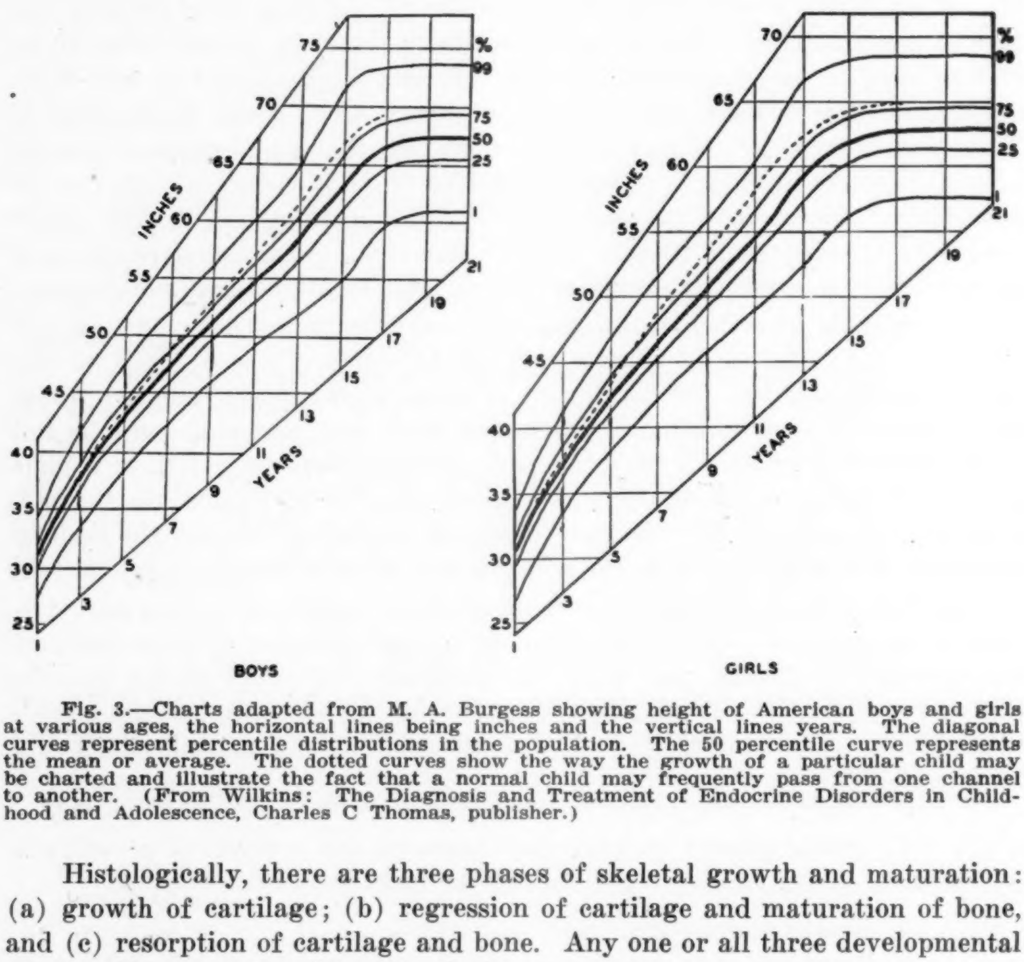


Fig. 3.—Charts adapted from M. A. Burgess showing height of American boys and girls at various ages, the horizontal lines being inches and the vertical lines years. The diagonal curves represent percentile distributions in the population. The 50 percentile curve represents the mean or average. The dotted curves show the way the growth of a particular child may be charted and illustrate the fact that a normal child may frequently pass from one channel to another. (From Wilkins: The Diagnosis and Treatment of Endocrine Disorders in Childhood and Adolescence, Charles C Thomas, publisher.)

Histologically, there are three phases of skeletal growth and maturation: (a) growth of cartilage; (b) regression of cartilage and maturation of bone, and (c) resorption of cartilage and bone. Any one or all three developmental phases of bone can be affected by the hormones.[10]

Standards have been established for the assessment of bone age.[11] As is true of other standards of measurement of somatic changes and configuration, there is a fairly wide range of variation in the appearance of the centers of ossification, even in individuals who may be termed "normal." Furthermore, the values of different ossification centers in the same individual are not constant. Certain centers in the same person may indicate more or less advancement or retardation than others, when examined at the same time. More than

one center is now being used to establish bone age. Some centers of ossification are more active than others at a given chronological age. For the orthodontist, the use of both hands and both wrists of the patient is considered adequate.

When other symptoms are absent, confirmation of maturative growth by means of wrist and hand roentgenograms is acceptable to indicate normal bone age. In using the hands and wrists it should be remembered that, as a rule, no new centers of ossification appear in the wrist between the ages of 7 and 9 years. During these years more stress should be placed on the changes in the outlines of the epiphyses, phalanges, metacarpals, and carpals. A deviation up to one year in bone age from an accepted standard is usually regarded to be within the range of normal variation, in the absence of other diagnostic criteria of a positive nature.[2]

3. *Dental Age.*—The stage of dental development is determined by the order of appearance, size, and amount of calcification of the tooth buds; deciduous tooth eruption; progress of calcification of the permanent buds; deciduous root resorption; permanent tooth eruption; and closure of the apices of the permanent teeth. The foregoing are compared to standard tables of normal dental growth and development.[13]

The progress of dental development is subject in large measure, but not as an invariable rule, to the same factors that influence skeletal development and general systemic maturation.[14] Retardation of dental development and eruption and alignment of the teeth in occlusion may be due to some specific interference with the process of tooth development and eruption or with the growth of the bone surrounding the teeth. Delay in dental development is usually, but not always, proportional to that in endochondral, skeletal, and general systemic retardation.[15]

4. *Skeletal Proportion.*—The ratio between the upper and lower body segments divided at the *symphysis pubis.* At birth the ratio is 1:1.7, with the upper segment being longer. By age 10 the segments are 1:1. Disturbances in body ratios are indicative of disturbed maturative growth.[16]

5. *Craniofacial Contours.*[17]—Head circumference, cephalic index, facial index, and other craniofacial measurements indicate craniofacial growth progress and are important factors in orthodontic diagnosis.

6. *Facial Features.*—The clinical appearance of the face is useful in determining maturative growth. For example, the naso-orbital configuration in cretinism is infantile, while in the pituitary dwarf it is preadolescent.[19] These patients look characteristically younger than their chronological age. There are other facies useful in determining developmental growth. In addition, there are the usual orthodontic criteria used to determine classification of facial abnormalities, micro- or macrognathia, and prognathism.[18]

7. *Endocrine Balance.*—Due consideration of endocrine correlation is indispensable in the diagnosis, prevention, interception, and treatment of dento-

facial abnormalities.[19] Elimination of endocrine disturbance can not only obviate, but actually correct, certain dentofacial abnormalities. While skeletal development is primarily genetically determined, it can be modified by intrinsic and extrinsic causes, including the endocrines.[20] The hormones can influence not only growth, but also maturation of the skeleton. The effects of endocrine dysfunction may show themselves directly in disturbed tooth formation and eruption and indirectly by interfering with the normal rate

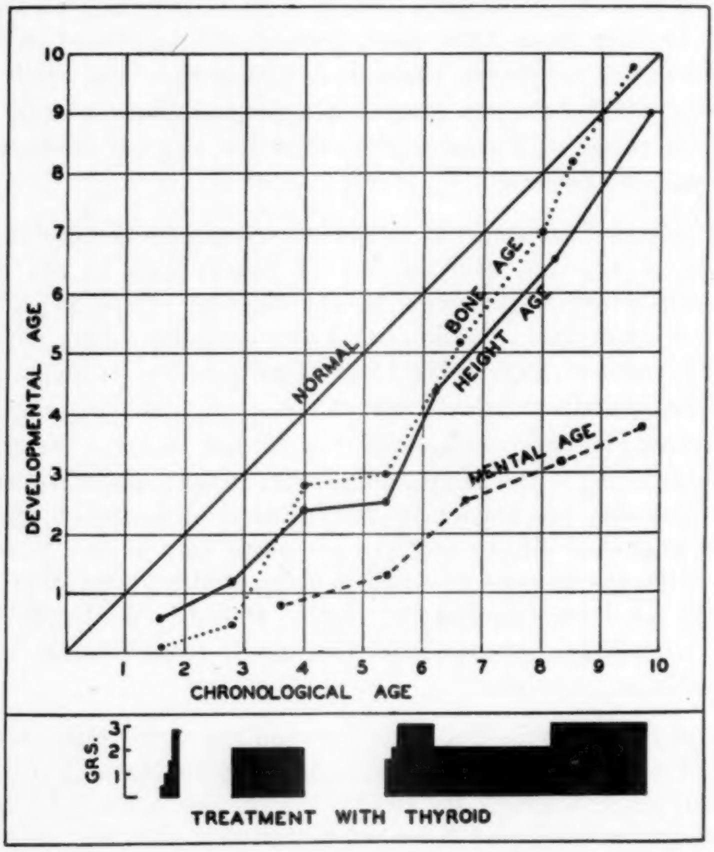


Fig. 4.—Chart illustrating method of following and comparing growth and development. Chronological age is plotted horizontally and developmental age vertically. The patient's "height age" indicates that he has the height of an average child of the same sex of the age specified. Such a chart permits a comparison of the rate of growth with that of osseous and mental development.

The case shown is a cretin whose thyroid medication was omitted during two periods because of failure of the parents to cooperate. The resulting retardation in growth and development are shown. By this method of charting, inadequate treatment sometimes is detected by a lag in growth and development, even when other signs of deficiency are not obvious. (From Wilkins: The Diagnosis and Treatment of Endocrine Disorders in Childhood and Adolescence, Charles C Thomas, publisher.)

and direction of growth and the physical characteristics of the bones.[21] The soft tissues of the mouth also are affected by endocrine disbalance.[22]

Wilkins[23] has devised a chart in which chronologic age is plotted along the abscissae and developmental age along the ordinates. This chart permits a comparison with the normal of the rates of growth, bone age, developmental age, sexual age, and mental development of individual patients. The chart is of value also in studying the effects of treatment on retardation (Fig. 4).

FACTORS RESPONSIBLE FOR GROWTH DISTURBANCE

The following, among other factors, are responsible for growth disturbances:

1. *Genetic or Constitutional Factors.*—These may be familial or sporadic. These types of growth disturbances may be seen in ovarian agenesis or as the result of organizer hormone deficiency which interferes with tissue differentiation during the embryonic stage.[24]

Examples of genetic factors acting directly on the end organs are found in achondroplasia, Mongolism, primordial dwarfism, and hereditary craniofacial dysostosis, disturbances in body build and size, and the sensitivity of the sex organs. Hypothalamic center disturbances of genetic origin can alter the pituitary or other endocrine glands, or may act directly on various body organs through the sympathetic nervous system.[25]

Congenital bodily defects may show linked syndromes with one or more of the endocrine glands or the hypothalamic center of the brain. Linkage includes ovarian agenesis, dwarfism, sexual precocity or retardation. and skin pigmentation.[26]

2. *Nutritional Deficiency.*—Growth requires adequate diet which is properly absorbed and utilized.[27]

3. *Metabolic Disturbances.*—Disturbed calcium-phosphorus metabolism, childhood diabetes, and hypocalcemia are a few examples.[28]

4. *Chronic Diseases.*—Examples are celiac disease, hepatic insufficiency, allergy, rickets, chronic renal disease, cystic fibrosis of the pancreas, childhood tuberculosis and others.[29]

5. *Bone Dyscrasias.*—Formation of bone is accomplished when phosphatase converts organic phosphorus into inorganic PO_4. The solubility product of Ca and PO_4 is thus exceeded and $Ca_3\ (PO_4)_2$ is deposited in the organic matrix of bone and in the teeth.[30] Examples of bone dyscrasias are chondrodystrophy, dysostosis, and osteogenesis imperfecta.[31]

6. *Circulatory Diseases.*—These include cardiac malformations, pulmonary deficiencies, and other conditions in which oxygen intake is interfered with.[32]

7. *Delayed Adolescence.*—This may be genetic or of inherent constitutional origin, or it may be associated with nutritional disorders or disease. Sexual development is retarded and may not begin until the age of 15 or later. Advancement in height and bone age continues, but is slow. Sexual development normally begins when bone age reaches 12 years, and may be accompanied by growth acceleration. In delayed adolescence sexual development occurs much later. Epiphyseal fusion and growth cessation also occur later than usual and the patient may reach normal height in these cases, but at a more advanced age.[33]

8. *Brain Defects.*—Hypothalamic disturbances can cause growth retardation or, conversely, acceleration.[34]

9. *Progeria* is a condition in which there is premature aging, plus dwarfism, with micrognathia and crowding of the teeth.[35]

10. *Endocrine Disturbances.*—The following dysfunctions, singly or in combination, cause disturbances of growth and development.

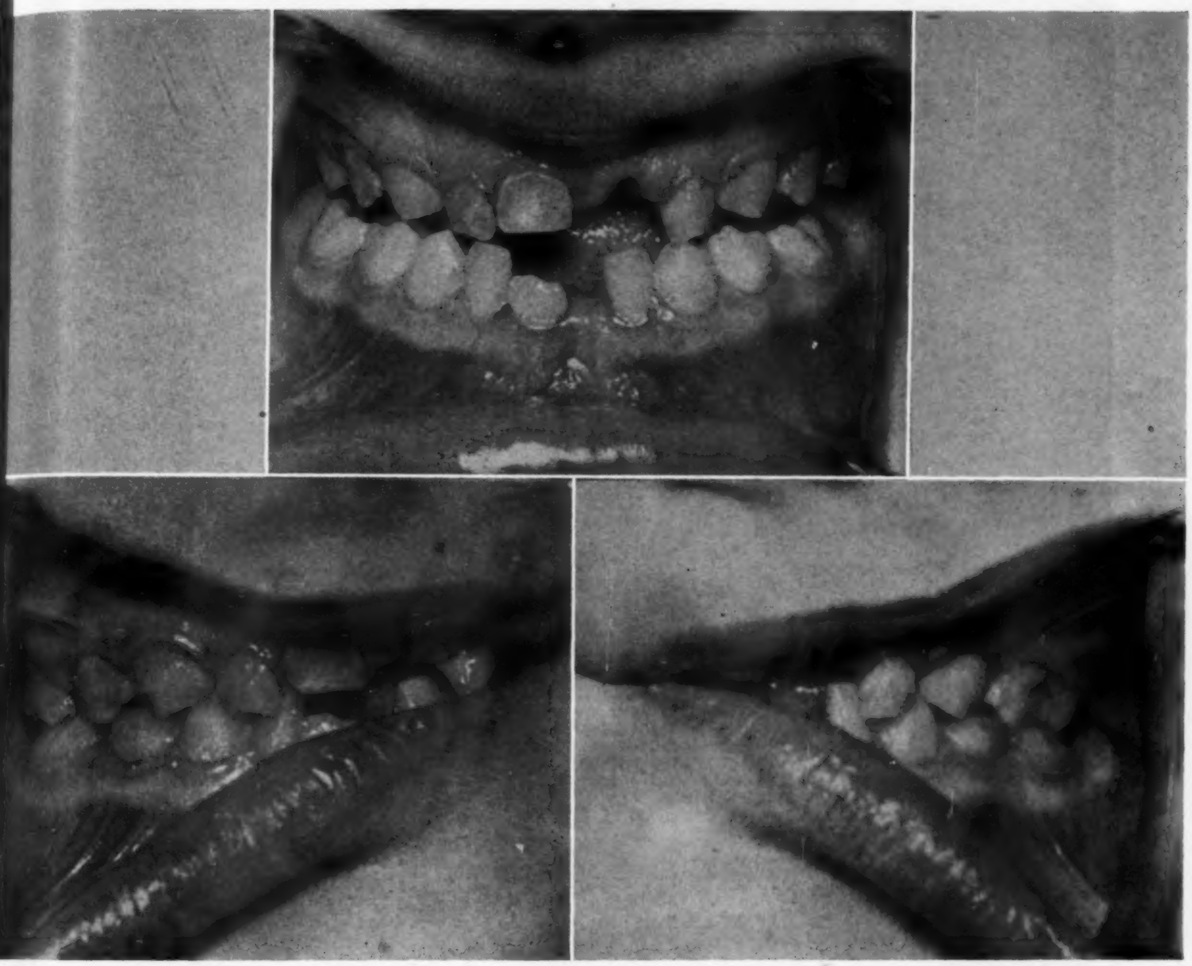
Fig. 5*A*.—Roentgenogram of the hand of a boy aged 8 years with congenital renal disease and tubular damage, renal diabetes, chronic loss of chlorides, and retarded growth and skeletal maturation. Carpal development is that of a 5-year-old.

NOTE: At the age of 8 years the wrist in the boy shows the following carpal bones: greater and lesser multangular, naviculare, lunate, hamate and triquetrum. The radial epiphysis is no longer wedge shaped. In the above photograph the greater and lesser multangular and naviculare are not formed. The radial epiphysis is wedge shaped.

a. Hypopituitarism or hyperpituitarism.
b. Hypothyroidism or hyperthyroidism.
c. Adrenocortical insufficiency or overfunction.
d. Gonadal disturbances.
e. Sexual precocity, with early closure of the epiphyses.

The symptoms in endocrine disturbances depend primarily on the age of the patient at the onset and the duration of the endocrine dysfunction. The effects may be mild and transitory or of varying degrees of severity. The most characteristic and constant structural changes in endocrine deficiency are

a.



b. *c.*

Fig. 5*B*.—*a*, Anterior view of dentition at age 9 of the same boy mentioned in Fig. 5*A*. The mandibular left permanent central incisor is erupting. None of the other permanent teeth has erupted. *b* and *c*, Views of occlusion of the deciduous dentition, showing normal occlusion and well-developed dental arches in the deciduous dentition.

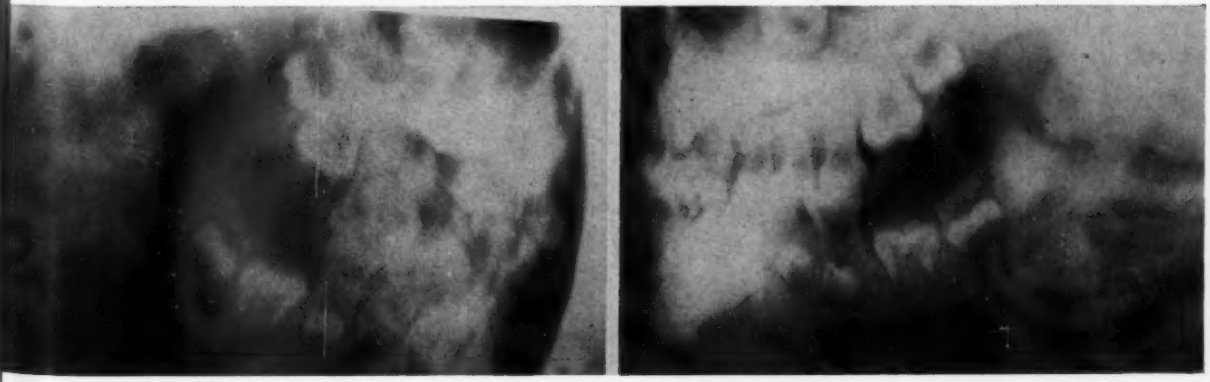


Fig. 5*C*.—Lateral jaw roentgenograms showing noneruption of permanent first molars. NOTE: At the age of 9 years this patient shows a dental age of 6½ years.

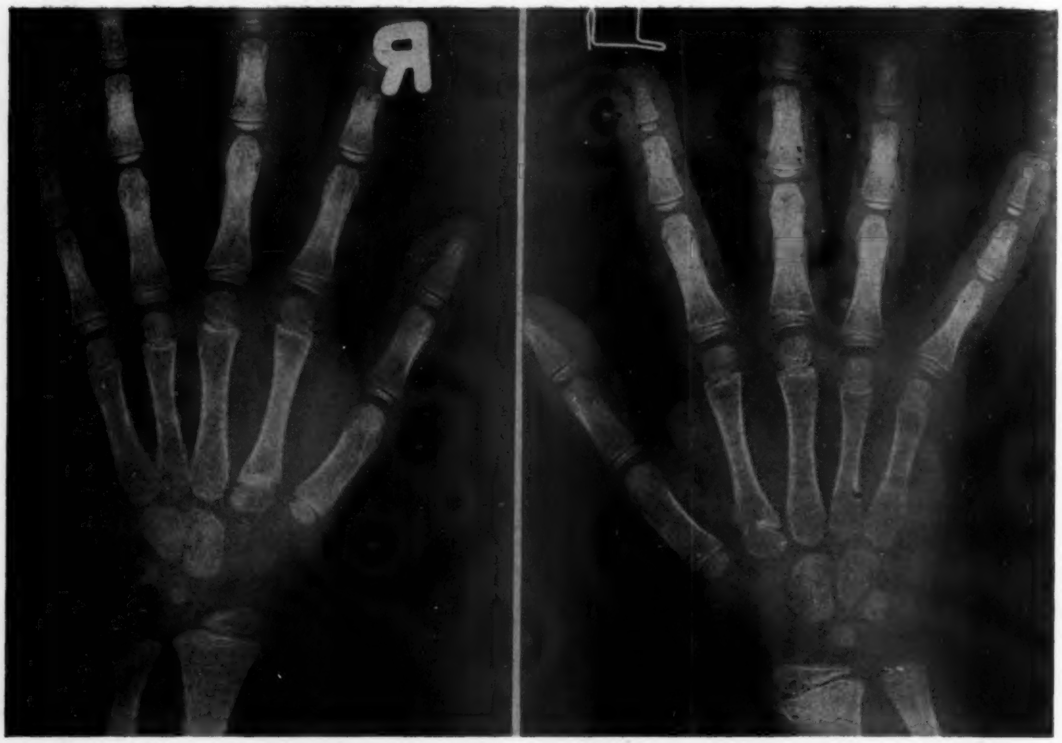


Fig. 6*A*.—Roentgenograms of right and left hands of a boy aged 7 years. The patient has congenital hypothyroidism with cretinism. He has received thyroid therapy since he was 5 months old. His bone age at the chronological age of 7 years is that of a child of 4 years.
NOTE: At age 7 the carpal development of boys shows the following: the ulnar epiphysis is present; all carpal bones except the pisiforme are present. In this patient the ulnar epiphysis is absent, as are the greater and lesser multangular, the naviculare and triquetrum. His bone age is that of a 4-year-old boy.

Fig. 6*B*.—Lateral jaw roentgenograms showing noneruption of the permanent first molars, although general dental development shows progress following thyroid therapy.

those caused by disturbances in growth and development of the skeleton, such as stunting or acceleration of growth, infantile skeletal proportions and naso-orbital configuration, gigantism and premature aging, accelerated or delayed and defective tooth development, epiphyseal dysgenesis, delay, or early closure of the epiphyses. Encountered also are large lips and thick tongue; iso- or heterosexual changes; hirsutism or, contrarily thin hair, pasty complexion, dull expression, painful muscles and joints, anorexia, poor nutrition, anemia, constipation, enuresis, restlessness, and many other symptoms.[36]

Endocrine dysfunctions associated with retarded general development usually produce also retardation in the growth of the oral tissues and organs, while those productive of accelerated general development can also accelerate the growth and development of the oral structures. Both general bodily acceleration and retardation can affect the development, eruption, and occlusion of the teeth and of facial development.[37]

DWARFISM

1. *Primordial Dwarfism.*—Primordial dwarfism is present at birth. There is normal osseous, dental, sexual, and mental development, but extreme retardation in physical growth.[38]

2. *Ateliotic Dwarfism.*—This presents generalized underdevelopment, characterized by infantile facial features, thin voice, slender limbs, and normal intelligence. The patient appears to be a miniature adult, in contrast to the cretinoid and achondroplastic types of dwarfs where physical disproportion is the rule.[39]

3. *Achondroplastic Dwarfism* is due to abnormal osteogenesis which begins early in intrauterine life as disturbance of chondrification and later in the ossification of the ends of the long bones. There is premature closure of the epiphyses. The membrane bones, for instance, those of the face, develop normally. There are characteristic physical disproportions in achondroplastic dwarfs. Dental development is not affected by this condition. When dental development is disturbed it is due to factors other than the achondroplasia.[40]

4. *Hypothyroid Dwarfism.*—When the condition originates in fetal life or in early infancy, it is known as cretinism and has a specific facies. Physical growth in cretins is markedly stunted. The upper and lower body segments show an infantile ratio of 1.7 (upper) to 1 (lower). There is a marked retardation in appearance and ossification of the carpal bones, and epiphyseal closure is retarded. Height is stunted, but not as much as bone age, which is extremely retarded. There may be myxedema present. The skin is coarse, dry, grayish, and may be mottled in appearance. The hair is coarse, dry, and brittle. There is poor circulation and poor muscle tone. The naso-orbital configuration is infantile, with the bridge of the nose underdeveloped, and the eyes appear widely spaced. The child *looks* infantile. Dental retardation in hypothyroidism parallels endochondral ossification, which is extremely delayed, but should not be accepted as a sole diagnostic criterion of hypo-

thyroidism. Delay of ossification of the tooth buds is more significant than retarded eruption. The tongue is large and thick. Sexual development is retarded.[41]

5. *Hypopituitary Dwarfism.*—There is a marked dwarfing, but no physical disproportion. There is an immature appearance of the face. The patient looks younger than he is, in addition to his retardation of growth. Epiphyseal closure is retarded. Sexual development is infantile. There is a low 17-ketosteroid output, which is indicative of sexual immaturity. In some cases bone age is less advanced than height age; in others bone age is higher, but both are retarded. Height is usually extremely retarded. Tooth eruption is retarded, the pulpal walls are wide and parallel and apical closure is delayed.[42]

6. *Delayed Adolescence.*—There is some dwarfing and delay in epiphyseal closure. Skeletal proportions are normal. The features are immature and sexual development is retarded, but tends to catch up. These patients show no endocrine or other metabolic disturbance. They are slow starters and finish late. The epiphysis may remain open until well into the third decade of life, and growth and maturation continue accordingly.[43]

GIGANTISM

Overgrowth in height is not as great a problem as dwarfism, at least as far as the United States is concerned, because tallness of stature is considered a desirable asset. When overgrowth appears, there is little that can be done about it of a therapeutic nature. In man, height over 79 inches is considered gigantism. Gigantism may be normal, eunuchoid, or acromegalic.[44]

In gigantism with the *adrenogenital syndrome*[45] there is excessive masculinization in females and rapid growth in height. In hormonal sex reversal or pseudohermaphroditism there is an excess of growth. Seckel found dental development practically unaffected in cases of excessive adrenogenic activity of the adrenal cortex which is usually responsible for the aforementioned growth increase. The amount of overgrowth depends on the age of the patient at the onset of the disease.

While the normal giant is proportioned in the same relative dimensions as the child of normal growth, the eunuchoid giant shows disproportion in physical components. The span of the outstretched arms from finger tip to finger tip equals or exceeds height. The upper part of the body is shorter than the lower portion. The eunuchoid giant retains the infantile facial features.[46]

1. *Pituitary Gigantism.*—Adenoma of the pituitary, when it occurs in childhood, brings about overgrowth in height or gigantism. When it starts in the adult it is referred to as acromegalia. Growth in pituitary gigantism may continue to the age of 25 or 30 years.[47]

2. *Hyperpituitarism* in early life produces early eruption of the deciduous teeth, overgrowth of the jaws, increased density of the jawbones, and

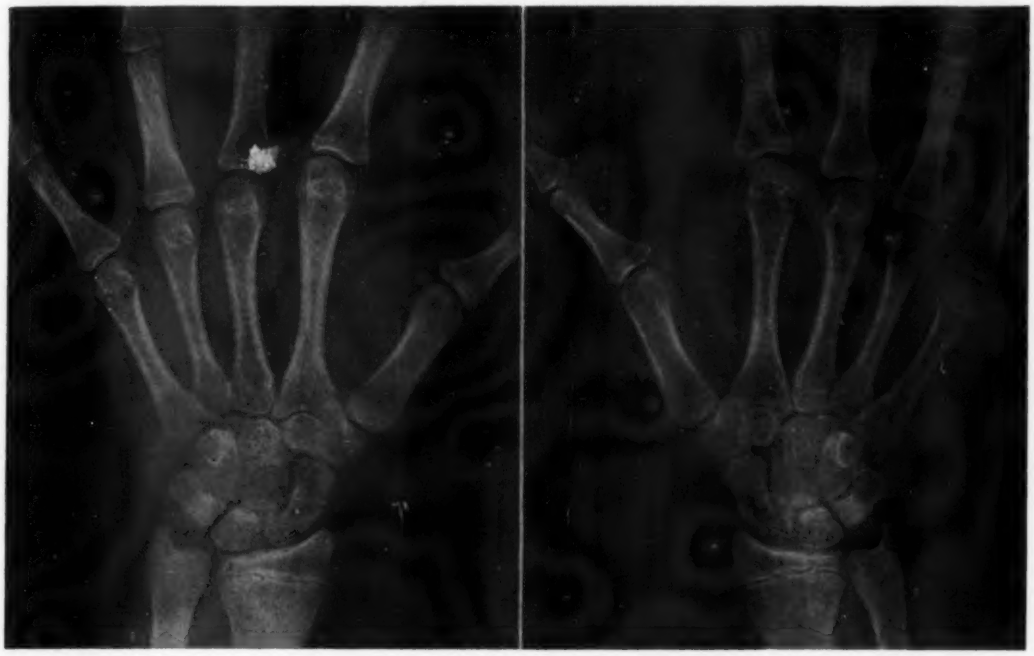


Fig. 7*A*.—Roentgenograms of hands of a girl aged 8 years with constitutional precocious puberty. Her bone age is 15 years, although her chronological age is 8 years.

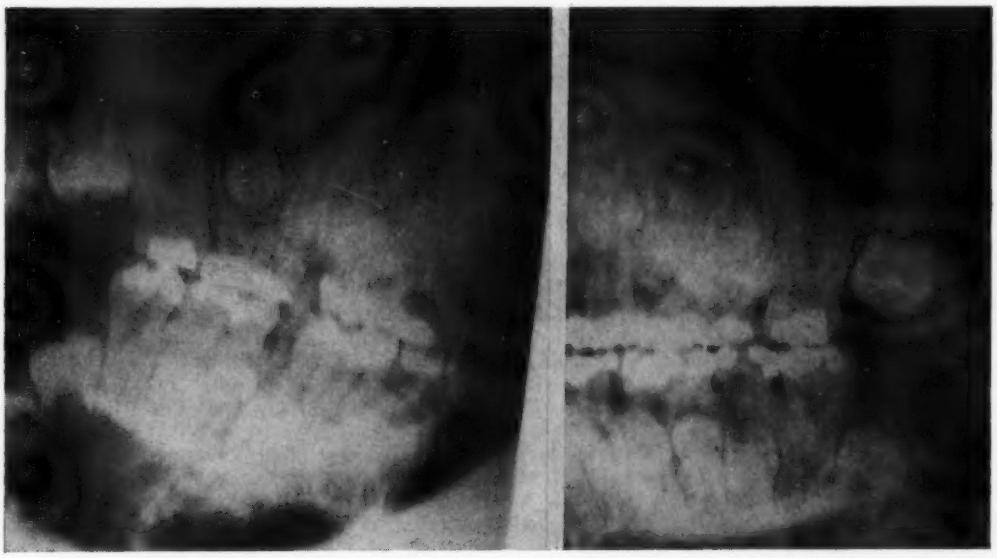


Fig. 7*B*.—Lateral jaw roentgenograms of the patient in Fig. 7*A*. The permanent second molars and all the premolars are unerupted. Her dental age is 8 years, the same as her chronological age.

prognathism. Irregular spacing of the teeth in the permanent dentition is usually present, especially in acromegalic gigantism.[48]

3. *Hyperthyroidism* is frequently responsible for overgrowth in height. The rate of growth and osseous development are accelerated in hyperthyroidism. Acceleration of dental development has been reported.[49]

SUMMARY

1. A knowledge of the medical history and physical status of the child is of prime importance in establishing a diagnosis and in determining the time when orthodontic intervention should be undertaken and the type of treatment to be instituted.

2. Cephalometric diagnostic criteria and mechanotherapy must be correlated with the factors responsible, not only for the malformations present, but also with those responsible for the general developmental status of the patient.

3. The characteristics of growth and development are presented, and criteria for assessing the status and progress of growth and development are discussed.

4. The factors most responsible for dentofacial growth disturbances are indicated.

5. The various types of dwarfism and gigantism are mentioned.

My thanks are due the departments of Pediatrics and Growth and Development of The Mount Sinai Hospital in New York City for their cooperation. I am especially indebted to Dr. Stanley L. Wein for his assistance in obtaining the diagnostic aids.

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654 MADISON AVE.

THE NORMAL POSITION OF THE MAXILLARY FIRST PERMANENT MOLAR

Arnold E. Stoller, B.S.D., D.D.S., M.S.D., Seattle, Wash.

ANGLE[1] referred to the maxillary first permanent molar as the "key to occlusion." A key may be defined as that by means of which a difficulty may be removed. The maxillary first permanent molar has been the tooth which is most commonly used as a key in classifying dentures as to occlusion. This study will attempt to show that a slight variation in the position of the maxillary first permanent molar may alter the interdigitation and balance of the entire denture. The difficulty encountered by the orthodontist in obtaining ideal cusp relation in his finished cases is often attributed to a discrepancy in the relative amount of tooth material in the opposing arches. If, however, the maxillary first permanent molars are not in their ideal position, they may cause the resulting malrelationship to appear to be due to a tooth size discrepancy. When there is a poor relation of dental cusps in the opposing arches, the etiology often may be traced to the position of the maxillary first permanent molar. A study of the maxillary first permanent molar and its position in normal occlusion often will make it possible for the orthodontist to better interdigitate the cusps on his finished cases.

Angle,[2] Hellman,[3] Strang,[4] Dewey,[5] and others have given detailed graphic descriptions of the inclined plane contacts in describing the normal cusp relationship of the first permanent molar. The certain outstanding features established to determine what is known as normal occlusion were stated by Anderson[6] as, "The occlusion of the mesiolingual cusp of the maxillary first permanent molar in the central fossae of the corresponding mandibular molar; and the occlusion of the mesiobuccal cusp of the maxillary first permanent molar in the buccal groove of the mandibular first permanent molar." However, most orthodontists overlook the academic detailed descriptions of the cusp and plane relation in normal occlusion and reduce the position of the maxillary first permanent molar to the simple statement that the mesiobuccal cusp of the maxillary first permanent molar occludes in the buccal groove of the mandibular first molar.

Strang[7] began his chapter on normal occlusion by describing the axial inclination of teeth in normal occlusion. This excellent chapter on normal occlusion should impress the orthodontist with the importance of considering the third dimension in tooth position instead of just the relation of the

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occlusal surfaces to each other. In this chapter on normal occlusion he states that normally there is always a tendency toward mesial axial inclination in the molars and that the buccal ridge on the mesiobuccal cusp of the first molar stands out so far buccally that it gives the arch form a distinct offset buccally as it passes from the second premolar to the first molar.

Attention has been given to the normal position in occlusion of the distobuccal cusp of the maxillary first permanent molar by various authors, but no particular stress has been placed upon it. Hellman[8] described the position of the distobuccal cusp as "the accommodation of the triangular ridges of the distobuccal cusp of the upper molars into the buccal embrasures between their lower namesakes and the tooth distal to it." In classifying the molar position, the distobuccal cusp relationship of the maxillary first permanent molar might well be of more significance than that of the mesiobuccal cusp.

In 1930, 3,982 students entering the University of California at Berkeley were given a dental examination by Orton and Lischer[9] and the results showed that less than 5 per cent possessed excellent natural dentures which are usually called "normal." From this small number of "normals" found, not one supplied a masticating organ which might be accepted as archtype.

A more recent dental survey by Massler and Frankel,[10] on 2,758 children, found that only 3 per cent had ideal normal occlusions. When we consider that only 3 to 5 per cent of our population have ideal normal occlusion, it is no wonder that more detailed comparative studies of them have not been made. The use of human skulls with ideal normal occlusions would be invaluable in tabulating normal findings, but the number of such human skulls are so rare that they have become museum pieces.

MATERIAL

The material used to demonstrate how the position of the maxillary first permanent molar effects the interdigitation of all the dental cusps was obtained from plaster record casts and photographs of skulls. Plaster record casts were obtained on a limited number of untreated ideal normal occlusions in adults. Casts of orthodontically treated cases in ideal normal occlusion and in occlusions which were good, but not ideal, were taken from my files.

FINDINGS

The ideal normal dental occlusions which had no orthodontic intervention, and those ideal normal dental occlusions which had orthodontic treatment, possessed a remarkably constant similarity in the orientation of the maxillary first permanent molar in relation to the adjacent teeth. It is the purpose of this article to demonstrate the factors which are constant, to demonstrate how they should be observed, and to describe how they may be obtained in orthodontic therapy.

The position of the maxillary first permanent molar in normal occlusion was noted to be such that the mesiobuccal cusp is slightly distal in its rela-

tion to the mandibular first permanent molar than is our usual concept. To demonstrate this, a line was drawn on the tooth to mark the center of the long axis of its mesiobuccal cusp. A line was drawn in the buccal groove of the mandibular first permanent molar. These lines were drawn on the models before they were photographed and on the photographs of the skulls after they were reproduced. On the skulls line "A" (the maxillary cusp) is found to be distal to line "B" (the mandibular groove). Likewise, on the record casts in ideal normal occlusion which had no orthodontic treatment

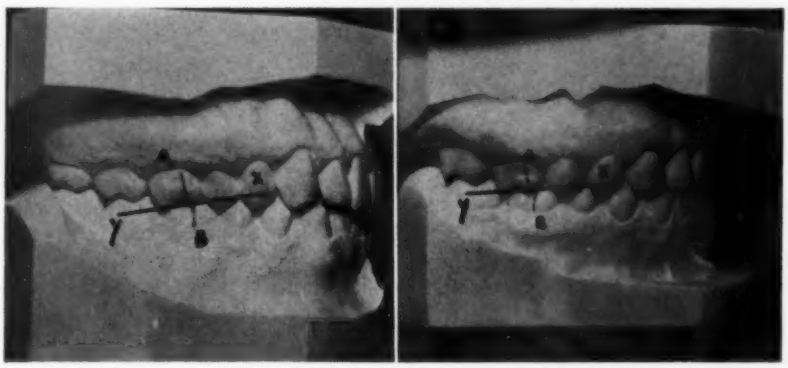


Fig. 1.—Record casts of untreated dentures in normal occlusion.

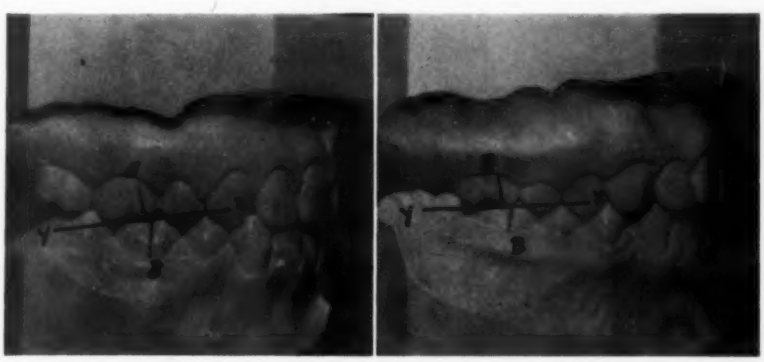
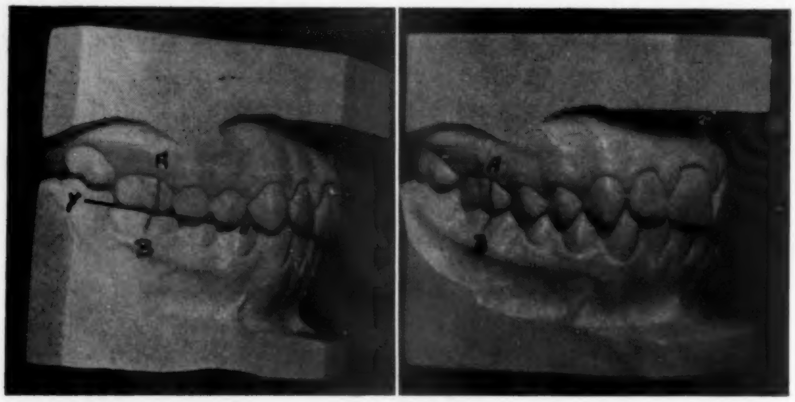


Fig. 2.—Record casts of orthodontically treated dentures in normal occlusion.

(Fig. 1), line "A" is distal to line "B." Fig. 2 shows an orthodontically treated case in normal occlusion; again line "A" is distal to line "B." Fig. 3 shows a case which has been orthodontically treated and is in good, but not ideal, occlusion. The lines "A" and "B" coincide. The occlusion may be justly described as the mesiobuccal cusp of the maxillary first permanent molar resting in the buccal groove of the mandibular first permanent molar. However, the cusps of the premolars and canines are not related properly for the ideal normal occlusion.

The orthodontist often makes the comment that a dental occlusion appears ideal to him until a record cast of the denture has been made. Fig.

3, *A* and *B,* shows photographs of the same casts. The first is a direct buccal view; the maxillary canine and premolars do not appear to interdigitate as ideally with the mandibular dentures as in *B*. The occlusion in Fig. 3, *B* appears to be better because it was photographed from a position slightly to



A. *B.*

Fig. 3.—Record cast of an orthodontically treated denture in good, but not ideal, normal occlusion. *A,* viewed directly from the buccal; *B,* viewed from an angle slightly to the anterior.

the anterior instead of directly from the buccal. The angle from which the photograph was taken is similar to the view one has of the denture as it is observed in the mouth. The interdigitation of the cusps appears improved from this slightly anterior angle because the maxillary buccal cusps overlap the mandibular cusps, and, being slightly mesial to their normal position, they

Fig. 4.

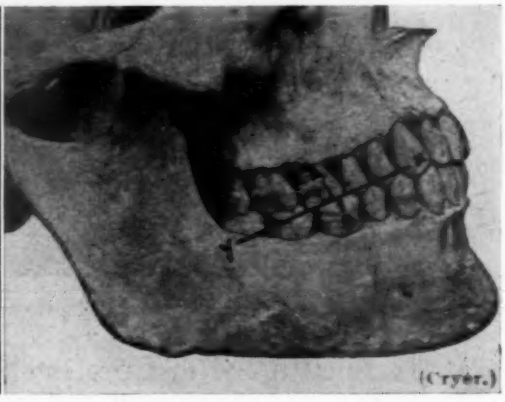


Fig. 5.

Fig. 4.—Normal occlusion skull. (Skull by Ketcham, from Strang: A Textbook of Orthodontia, ed. 3, Lea & Febiger, publisher.)

Fig. 5.—Normal occlusion skull. (Skull by Cryer, from Angle: Malocclusion of the Teeth, ed. 7, S. S. White Dental Mfg. Co., publisher.)

hide from view the minor discrepancies in articulation. It is therefore important to view the occluded denture, both in the mouth and on the casts, directly from the buccal side in order to observe the correct mesiodistal relation of the cusps.

Fig. 6. Fig. 7.

Fig. 6.—Normal occlusion skull. (Skull by Summa, from Angle: Malocclusion of the Teeth, ed. 7, S. S. White Dental Mfg. Co., publisher.)

Fig. 7.—Normal occlusion skull. (Wistar Institute of Anatomy after Turner and Anthony.)

Fig. 8. Fig. 9.

Fig. 10. Fig. 11.

Fig. 8.—Normal occlusion skull. (From Wheeler: A Textbook of Dental Anatomy and Physiology, W. B. Saunders Company, publisher.)

Fig. 9.—Normal occlusion skull. (Skull by Broomell, from Strang: A Textbook of Orthodontia, ed. 3, Lea & Febiger, publisher.)

Fig. 10.—Normal occlusion skull. (Skull by Peeso, from Strang: A Textbook of Orthodontia, ed. 3, Lea & Febiger, publisher.)

Fig. 11.—Normal occlusion skull. (From Wheeler: A Textbook of Dental Anatomy and Physiology, W. B. Saunders Company, publisher.)

The maxillary first permanent molar has a mesial axial inclination in ideal normal occlusion. Strang[11] defined the term "mesial axial inclination" of a tooth as "when the crown is mesially located to the vertical plane on which the apical portion of the root is placed." The mesial axial inclination of the maxillary first permanent molar places the tip of the distobuccal cusp farther to the occlusal than the mesial buccal cusp. The distobuccal cusp in occlusion rests well down into the embrasure between the mandibular first and second molars.

Fig. 12.—Normal maxillary first permanent molar, buccal aspect. (From Wheeler: A Textbook of Dental Anatomy and Physiology, W. B. Saunders Company, publisher.)

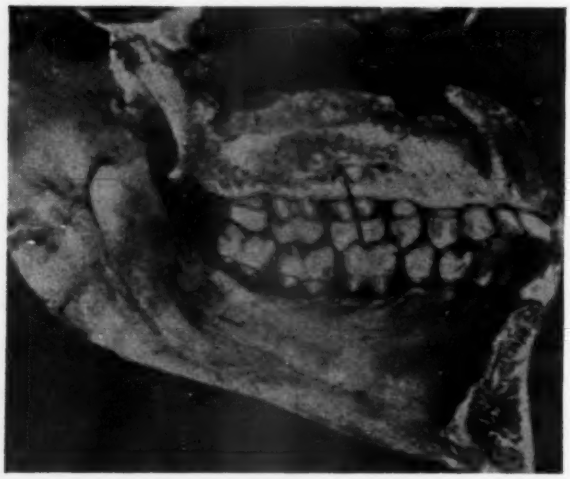


Fig. 13.—Cross section of skull in normal occlusion. (Skull by Peeso, from Strang: A Textbook of Orthodontia, ed. 3, Lea & Febiger, publisher.)

To demonstrate the mesial axial inclination an extended line (x-y) was drawn on photographs of the skulls in which there was ideal occlusion. This line touched the tips of the buccal cusps of the maxillary first permanent molars. In cases with ideal normal occlusion, the mesial extension of this line was superior to the plane of occlusion and the distal extension of this

line was inferior to the plane of occlusion. Figs. 1 and 2, and Figs. 4 to 11 also show that the distobuccal cusp appears to be longer than the mesiobuccal cusp. Wheeler[12] shows in Fig. 12 that normally the two cusps are approximately the same length. Therefore, the roots of these teeth must be distally tipped to allow the crown to assume this position.

A view of the maxillary first permanent molar from the lingual (Fig. 13) shows line "A" drawn on the long axis of the tooth. This line has a distal inclination from the occlusal surface toward the root apex. Note the locking of the distolingual cusp in occlusion.

Fig. 14.

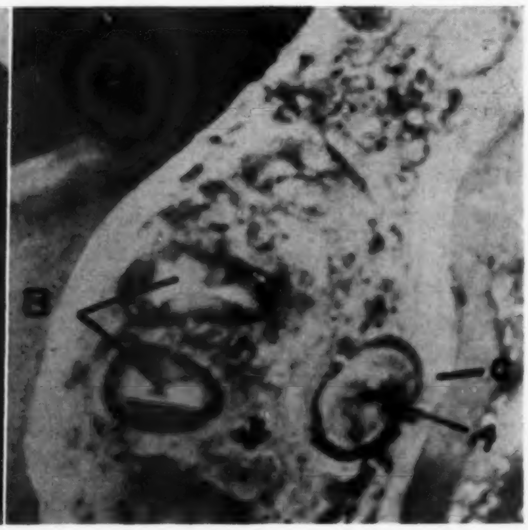


Fig. 15.

Fig. 14.—Occlusal view of skull showing arch form. (From Turner and Anthony: The American Textbook of Prosthetic Dentistry, ed. 5, Lea & Febiger, publisher.)

Fig. 15.—Cross section of maxillary first permanent molar roots just apical to crown. *A*, Lingual root; *B*, buccal roots; *C*, lingual cortical plate. (From Atkinson: J.A.D.A. 24: 564, 1937.)

Now we consider a case in good, but not ideal, normal occlusion (Fig. 3, *A*). The extended line drawn to touch the tips of the buccal cusps of the maxillary first permanent molar was nearly parallel to the occlusal plane. It was noted that when line x-y was tipped favorably, as shown in the ideal normal occlusion case, the premolar and canine cusps had excellent interdigitation with the mandibular teeth. When line x-y was not tipped, but more parallel to the plane of occlusion (Fig. 3, *A*), the maxillary buccal cusps are slightly mesial to the mandibular embrasures. This discrepancy appears to be greater in the canine area. The maxillary canine appears "to ride up" on the mandibular canine. This "riding up" is very often seen in finished orthodontic cases and is a factor in the collapse of the lower anterior teeth after retention.

The maxillary first permanent molar in normal occlusion as viewed from the occlusal surface shows a definite orientation of this tooth to the arch form (Fig. 14). There is a change of direction in the buccal segments of the

arch at the maxillary first permanent molar. The canine and buccal cusps of the premolars are in line with the mesiobuccal cusps of the first molar. The buccal cusps of the second molars are in line with the distobuccal cusp of the first molar. The change in arch form at this point gives the maxillary first permanent molar another qualification to designate it as the key to occlusion.

When the maxillary first permanent molar drifts mesially into malocclusion the tooth rotates on its mesiolingual cusp. This large mesiolingual cusp rests in the central fossa of the mandibular first permanent molar and the tooth rotates on it as an axis. Fig. 15 shows a cross section of the maxillary first permanent molar and the investing tissue just apical to the crown of the tooth. The large lingual root *A* is seen approximating the lingual cortical plate. The space between the buccal and lingual cortical plates becomes narrow anterior to the first molar roots. As pointed out by Atkinson,[13] when the first molar drifts mesially, the large lingual root contacts the lingual plate and allows the two buccal roots to rotate mesiolingually. With this rotation the alignment, in the arch form, of the buccal segment changes. The two buccal cusps now lie in line with those of the premolars and canine.

The occlusal surface of the first permanent molar is trapezoidal in shape, the long diagonal being from distolingual to mesiobuccal, Therefore, when this tooth rotates mesially on the lingual root as the axis, more mesiodistal space is used in the dental arch. This use of more space in the arch by the molar is reflected in the anterior positioning of all cusps mesial to it. Hence, care must be taken to rotate such a molar distolingually, if good cusp interdigitation is to be accomplished in the finished orthodontic case.

DISCUSSION

The significance of the proper positioning of the maxillary first permanent molar was first brought to my attention by a case in which a pretreatment wax "setup" was made. When the case was first "set up" in wax, the mesiobuccal cusp of the maxillary first permanent molar was placed in the buccal groove of the mandibular first molar. The premolars were articulated, but when the maxillary canine was placed it would not interdigitate ideally without excessive grinding of the mesial inclined plane. The maxillary canine was too far to the mesial and appeared to "ride up" on the mandibular canine. To gain enough space to allow the maxillary canine and premolars to be placed farther to the distal, the molar was then rotated distally on its mesiolingual cusp. A slight amount of space was obtained by this movement but not enough to allow the maxillary premolars and canines to articulate properly. Often at this point it is assumed that there is an inequality of tooth structure in the opposing dental arches. This assumption was ignored and the "setup" case was approached from a different aspect. Strang[14] made the statement that, "Next in importance to the molar relationship as keys to normal inclined plane contact is the occlusion of the maxillary canines." With this in mind, the maxillary canine was articulated first and then followed by the premolars and molars. When this was accomplished, the

maxillary first molar was still not in proper occlusion with its antagonists. In order to view the first molar occlusion directly from the distal, the second molars, maxillary and mandibular, were removed from the record casts. A good molar articulation was then obtained by tipping the crown of the maxillary molar so that the distobuccal cusps were more deeply seated in the mandibular embrasure. This position gave the crown a mesial axial inclination and the mesiobuccal cusps of the maxillary first molar rested slightly distal to the buccal groove of the mandibular first molar. The second molars, maxillary and mandibular, were then articulated. The variation in the second molar occlusion from the original occlusion was observed in the position of the mandibular molar. This tooth was in infraversion with respect to its original position.

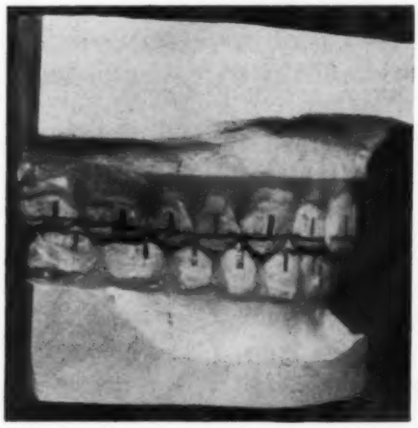


Fig. 16.—Pretreatment setup marked to show position of attachments and bands.

A comparison then was made of the molar positions thus achieved to those of normal untreated dentures and orthodontically treated dentures with poor canine and premolar articulation.

There was a similarity of position of the first molar in the ideal wax "setup" case and the normal dentures, as related to arch form. The rotational position of the maxillary first molar was such that its mesiobuccal cusp was in line with those of the premolars and canine; while its distobuccal cusp was in line with those of the second molar. The cases observed that were orthodontically treated but did not have ideal buccal cusp interdigitation often showed adequate rotation by this criterion. Hence, the rotation of the maxillary first molar per se does not always gain the space necessary for the ideal intercuspation of the premolars and canines.

When the axial inclination of the maxillary first molar in the ideal denture "setup" (Fig. 16, line x-y) was found to be similar to that in the normal dentures, it then was compared with the cases with good, but not ideal, buccal occlusion (Fig. 3). In these cases instead of the favorable mesial axial inclination, the long axis of the molar was nearly vertical. Therefore, the distobuccal cusp did not assume its favorable locked position well down

into the embrasure between the mandibular first and second molars. The locking of this distobuccal cusp should provide for better retention of the case after orthodontic treatment.

The relation of the mesiobuccal cusp of the maxillary first molar to the buccal groove of the mandibular first molar in occlusion was similar in the normal dentures and the denture "setup." The mesiobuccal cusp of the maxillary molar was slightly distal to the buccal groove of the mandibular molar and noticeably so when viewed directly from the buccal. The cases observed, which had poor buccal cusp interdigitation, varied from the normal dentures in that the mesiobuccal cusp of the maxillary molar was well in the buccal groove of the mandibular molar and often slightly mesial to the groove (Fig. 3). When we consider that the large mesiolingual cusp of the maxillary first permanent molar rests in the central fossa of the mandibular molar, the direct distal movement of the maxillary molar is not feasible. Therefore, the proper mesiodistal cusp relation is obtained by a combination of the distolingual rotation of the buccal cusps and the mesial axial inclination of the tooth.

Previously it was mentioned that the ideal position of the maxillary first molar was obtained in the denture "setup" prior to the articulation of the second molars and that when they were articulated the mandibular molar was in infraversion with respect to its original position. It must be assumed, then, that the mandibular molar has erupted into a position of supraversion relative to the mandibular first molar. Normal dentures were observed and the mandibular second molars were found to be in a position sufficiently in infraversion to the first molar to allow the maxillary first molar to maintain a mesial axial inclination without cusp interference. In the cases observed which had poor buccal cusp occlusion, the mandibular second molar had erupted to such a position that, should a correction of the axial inclination of the maxillary first molar be attempted, it would necessitate the depressing of the mandibular second molar, thus eliminating cusp interference. The etiology of the mandibular second molar assuming this position of supraversion relative to the mandibular first molar may be explained as follows: The eruption of the mandibular second molar usually precedes that of the maxillary second molar; therefore, it may erupt until it makes contact with the distal cusps of the maxillary first molar. However, when the maxillary first molar has drifted mesially, it allows the mandibular second molar to erupt into supraversion. Therefore, to accomplish a favorable maxillary first molar axial inclination, it is necessary to depress the mandibular second molar and thus eliminate cusp interference.

APPLIANCE THERAPY

The orientation of the maxillary first permanent molar into normal occlusion, as has been described, may be simplified by following a few suggestions in appliance therapy:

1. It is necessary to eliminate the supraversion of the mandibular second permanent molar. This may be accomplished in a multiband

technique by banding the mandibular second molars and placing its attachment as far occlusally as is possible. When the mandibular second molar is not sufficiently erupted to be banded, an extension may be soldered to the lingual arch and adapted to rest on the occlusal surface of the second molar. This extension may be adjusted to correct the supraversion of the second molar to the first molar.

2. The attachment on the buccal of the maxillary first molar may be placed in such a position that the mesial axial inclination will be accomplished with a minimum number of compensating bends in the arch wire. When the band for this tooth is formed parallel with the tips of the buccal cusps, the buccal attachment should be placed on the band at such an angle that its mesial edge is directed toward the incisal. A straight-arch wire placed into this attachment will accomplish the mesial axial inclination.

3. When the buccal attachment on the maxillary molar band is placed toward the mesial angle of the tooth, the favorable distolingual rotation of the buccal cusps will be accomplished with a minimum number of compensating bends in the arch wire.

The normal position of the maxillary first permanent molar has been described with some detail concerning its cusp relation, rotation, and axial alignment. With these basic factors in mind, the orthodontist needs to deviate from them in a major or minor degree as warranted by the case under treatment. Therefore, the use of a pretreatment "setup" will provide a diagnostic aid which is invaluable in predetermining the position of the bands and attachments. Fig. 16 is a pretreatment "setup" which has been marked to demonstrate the ideal position of the bands and attachments. This guide makes it possible to place the bands and attachments so that the normal tooth position may be accomplished with a minimum amount of arch wire manipulation.

SUMMARY AND CONCLUSION

1. A study of the normal position of the maxillary first permanent molar often makes it possible to obtain better cusp interdigitation and balance in the completed orthodontic case.

2. Faulty positioning of the maxillary first permanent molar may cause the resulting unbalance of occlusion to appear to be due to a tooth size discrepancy in the opposing arches.

3. The position of the maxillary first permanent molar in normal occlusion was noted to be such that its mesiobuccal cusp occludes distally to the buccal groove of the mandibular first molar.

4. It is important to view the occluded denture directly from the buccal in order to observe correctly the cusp relationship.

5. The maxillary first permanent molar has a mesial axial inclination which positions its distobuccal cusp well down into the embrasure between the mandibular first and second molars.

6. There is a change in direction of the normal dental arch, at the maxillary first permanent molar, which is obtained by the proper distolingual rotation of the buccal cusps of this tooth.

7. Due to the shape of the maxillary first permanent molar the distolingual rotation of its buccal cusps, when the tooth is in mesio-occlusion, provides more space in the dental arch. This movement does not always gain sufficient space to obtain proper interdigitation of the canine and premolars.

8. The maxillary canine articulation which appears to "ride up" on the mandibular canine often may be caused by minor faults in the orientation of the maxillary first permanent molar.

9. The correction of the canine articulation may prevent relapse in the alignment of the lower anterior after the retention period.

10. The pretreatment "setup" is invaluable in predetermining ideal tooth, band, and bracket position.

11. The articulation of the canine, first, in the pretreatment "setup" will aid in the proper interdigitation of the cusps in the premolar and molar region.

12. The removal of the maxillary and mandibular second molars from the pretreatment "setup" often will prevent cusp interference in the articulation of the maxillary first permanent molar.

13. The mandibular second molar is often in supraversion relative to the position of the mandibular first molar when the maxillary first molar is mesial to its normal position.

14. The suggestions made for treatment therapy to correct the malposition of the maxillary first permanent molar are:

a. Depressing of the mandibular second molar.
b. Placement of buccal attachment to accomplish proper axial inclination.
c. Placement of the buccal attachment to accomplish proper rotation.

The minor discrepancies of tooth cusp interdigitation in orthodontic cases are often the most difficult to eliminate. Therefore, it is important to study the normal untreated denture to accomplish this end. The rarity of normal untreated denture material should stimulate the orthodontic profession to compile as much of this type of data as is possible for detailed comparative study.

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ORTHODONTIC TRENDS—PAST AND PRESENT

H. C. POLLOCK, D.D.S., ST. LOUIS, MO.

WHEN the suggestion came from your Program Committee that I report an editor's impression of orthodontic trends over a period of years, it struck a responsive, and at the same time a reluctant, chord. I am well aware of the belief traditionally held by editors of highly specialized journals that to speak well of the accomplishments of the specialty makes popular copy, but to refer to its limitations makes unpopular reading.

At the same time, the suggestion of the Program Committee sparks an urge, that I hope is understandable, to contribute an editor's impression of some trends that are taking place which will stimulate thought and consideration. The assignment was accepted by adding that if the "scoreboard" as reflected from your editor's desk is of interest aside and apart from the scientific text that is read each month in your JOURNAL, then I will be very happy to look at the record in retrospect with the anticipation of your tolerance, understanding, and mutual interest.

He who reads specialized manuscripts and opinions from all over the world soon becomes aware of the fundamental fact that a regular routine of events occurs—just like night follows day. All important developments and trends are preceded by a build-up of the forces involved. This sequence is evident in all political, economic, and scientific development, and one step brings on another. He who sees these forces at work tries to look upon them with anticipation as the reflection of things to come.

The specialty of orthodontics has made a very spectacular growth during the past half century. Therefore, it now finds itself facing the responsibilities of the other health professions. This new status seems to have taken us somewhat off-base. However, it obviously is not too early to give some careful attention to some things that are happening.

There seems to be little doubt among many who are familiar with the step-by-step history of the specialty that the long-pull change during the past fifty years has been the slow shift from the status of a simple mechanical craft or skill in the beginning, called the "regulation of the teeth" to what we now think, or hope, is an important specialized health service.

HOW IT ALL STARTED

If you have read the record, you found that very little attention was paid to the regulation of teeth whatsoever just before, you may say, the Chicago

Read before the American Association of Orthodontists, Dallas, Texas, April 30, 1953.

World's Fair in 1893. At about that period of dental advance, when the average dentist was confronted with a malocclusion problem, he extracted some teeth in about the same way as was done during the days of the Greek and Roman Empires. Teeth were extracted as routine procedure, and others were then allowed to migrate much as water seeks its level. That was the popular routine previous to the time that Angle and his protégés started the all-out educational drive to maintain the full complement of teeth and institute orthodontic treatment for the ultimate goal of the normal occlusion of teeth.

That amazing drive by Angle and his crowd marked the renaissance of what we know as modern orthodontics, and if it were not for that incident one-half century ago, no doubt there would be no meeting here today to talk about the subject of orthodontics.

Angle's creed quickly jumped on the bandwagon, took the spotlight, and held on for many years. That creed almost made a fetish out of the teaching theme of the full complement of teeth and the fiction that the permanent first molar erupts in its proper position in the cranium and that all malocclusion can be classified according to certain symptoms, as indicated by the relative position of the teeth. This was accepted as the orthodontic law of the land and was taught as basic, fundamental teaching in schools and textbooks throughout the world. Few had the temerity to dispute those principles.

About the time of World War I some of Angle's former students, after being out in practice for some years, came up with some new ideas. The Oppenheim, Hellman, Mershon, and LeRoy Johnson influence was born, and that impact practically shocked the young specialty into the full realization, for the first time, that malocclusion basically is a biologic-physiologic problem subject to the attributes of growth, health, and disease manifestations of the entire body. Orthodontists then became conscious that they were dealing with biologic, infinite variation, instead of a simple mechanical craft alone.

The Oppenheim, Hellman, Mershon and Johnson group, while working separate and apart, seemed to see eye to eye on what orthodontics was all about, to put more emphasis on life processes than on mechanical procedures, and to see malformation in the framework of the total patient, rather than screw threads and nuts.

The Good Samaritan Clinic of Atlanta contributed some new ideas by C. C. Howard, an orthodontist, by Arch Elkinn, M.D., an endocrinologist, and William Englebach, M.D., also an endocrinologist. Englebach was an international figure and authority in endocrinology. He soon recognized certain types of malocclusion as classical symptoms, associated with the syndrome of glandular disturbances, known as acromegaly and other diseases. Orthodontists were then again both amazed and bewildered when they found out by documented evidence that in the treatment of certain types of malformations, they were merely pulling on their own bootstraps, using mechanical devices to treat symptoms instead of the disease. After that evidence appeared, many orthodontists regarded the treatment of many cases of Class III malocclusion as highly speculative with a high-risk rate of success.

Previous teaching ignoring heredity notwithstanding, somebody about that time came up with the common-sense observation that, after all, the fertilization of the original chromosomes may have something to do with malocclusion, as it does with the color of the eyes or the shape of the ears. What a consternation that caused to most of us whose background in orthodontics was based on the proposition that the answer to the problem lies in the clever and skillful manipulation of gadgets of various kinds! LeRoy Johnson and others then started to talk and write about genes, genetics, and Mendel's Law. Thus, things were becoming a little more clear and scientific in the over-all thinking.

The Simon diagnostic theory of gnathostatics then came from Germany and made quite an impact on diagnostic theories. It was pointed out by its sponsors that the traditional first molar buccal groove diagnostic routine was a fictional concept and needed serious re-examination. There was a proposal to broaden the diagnostic ideas to a more comprehensive base than the traditional position of the upper first molar. This led to the Broadbent-Bolton study and was plainly the advance trend that led to present-day cephalometric concepts of growth and so-called treatment planning ideas.

Next, the European influence came along; Lockett, Friel, Mathews, Lundstrom, and others appeared on the program of the first International Orthodontic Congress in New York in 1926, and talked about the apical base and its importance in tooth movement.

The greatest challenge to the basic Angle concepts came, however, when the Bolton study, and the research started by Broadbent and Todd, led to roentgenographic cephalometrics. Along came the Tweed contributions of 1930 to 1940. A group was established that directed attention to the variation in growth of the maxillary bones as related to facial bones. They pointed out that, in their opinion at least, the so-called expansion of bone by orthodontic treatment, as advocated by Angle for so many years, is also fictitious. That assumption represents one of the forces that led up to the present trend of the extraction of four premolar teeth, ostensibly to compensate for insufficient bone, bulk, and structure to accommodate all of the teeth.

That premise led to more and more root-moving appliances, called "mechanisms" and "philosophies," that proposed to influence the apical base in treatment as previously advocated by Lundstrom. That same premise led to the assumption that the mandibular teeth should first be tipped back to an upright position in Class II cases to correct the malposition of the teeth and malrelation of the jaws in order to prevent the mandibular teeth from being tipped forward.

Now some groups have really gone all out on the extraction routine. We find authors advocating "quick treatment" (particularly in foreign countries), advocating the extraction of four first premolars along with four first molars. Eight teeth are extracted in all in some cases, as a compensation measure.

The Angle group, then, did found a specialty about the start of the century on the basic foundation of the full complement of teeth and normal occlusion as the ultimate goal in treatment. Now, due to the previously mentioned

trends that have developed over a period of years, much of that has changed. Something has evolved somewhat of a paradoxical situation that you might call, for the sake of brevity, extraction of teeth unlimited. One group advocates the extraction of teeth with utter abandon of the basic principle that served for the foundation of the specialty. Another group advocates the extraction of four premolars, pretty much as basic practice. Still another group advocates extraction only as a compromise and last resort in treatment. From the outside looking in, that is all too far apart and does not make much sense to anyone familiar with health services, particularly physicians and dentists.

Upon this particular basic question, then, orthodontics seems to be just about back to where it started during the latter part of the last century. It has proved, figuratively speaking, that the "world is round" and everybody knows that nobody knows all of the answers, all claims to the contrary notwithstanding.

Unfortunately, the public, the dental profession, and the medical profession are in complete bewilderment at these goings-on of such violent opposite opinion among a highly specialized group. No doubt the right answer to this question sooner or later will be found some place in the middle between the two extremes. It will require a great deal of time for the "wheel to turn over," however, and for the clinical observation and recording of many faces in middle life of persons whose teeth have been extracted in adolescence for the purpose of correcting malocclusion of the teeth. The question obviously stems from this: how far can you go in the extraction of teeth in childhood without causing facial underpinning and contour defects to appear in adult and middle age? The plastic surgeons are making a great to-do to hold all of the teeth in the mouth in order to avoid the high velocity of atrophy of osseous tissue in middle age.

LEADERS

There were only a handful of men in America giving serious thought and study to the subject in the Gay Nineties. Orthodontics was not a popular subject; it was regarded with skepticism and as a highly speculative department of dental practice. To name some of the important figures of that day, there were Victor Hugo Jackson of New York, author of a textbook and originator of the so-called Jackson Removable Crib; Henry Baker of Boston, who originated the Baker anchorage; Norman Kingsley of New York, who created the Kingsley splint; Calvin Case of Chicago, author and teacher (one of the first to advocate the extraction of teeth followed by orthodontic treatment); Guiliford of Philadelphia, author of a textbook; Walker of New Orleans, a clever artisan and a pioneer of the removable appliance; Gaston of New Orleans; and last, but by no means least, Edward H. Angle. The latter, an international figure in orthodontics, conceived those basic principles that were universally accepted and that caught on. Some of his ideas are still basic today, and some are not.

Angle was no doubt the most inspirational indoctrination teacher who ever taught the subject of orthodontics in all time.

The characteristics which make a man an outstanding and forceful teacher are so complex and interwoven that any analysis of them is almost futile. There were teachers and leaders in orthodontics in the sense of the old philosophers who gathered about them groups of students who learned, not through formal teaching alone, but through the inspiration and enthusiasm of their instructors. That early teaching in reality was indoctrination and briefing on a crusading level, now a kind of lost art in most of the teaching of the health services. Nonetheless, it caught on and started a lusty specialty of dentistry and became somewhat of a pattern for orthodontics and is very much emulated even to this day among some orthodontic groups.

Another school was started in St. Louis, Mo., about the start of the century. It was called the International School of Orthodontia and was founded by B. E. Lischer and the late C. D. Lukens. This school was later taken over and operated for years by William Brady and Hugh Tanzey of Kansas City, Mo. This school preached the same gospel: the Angle routine and the full complement of teeth and the sanctity of the position of the upper first molar in the skull.

A brilliant and highly individualistic teaching protégé of Dr. Angle, Martin Dewey, then started the Dewey school of orthodontia in Kansas City, Mo. Dewey likewise adopted all of the Angle postulates as the law of the specialty of orthodontics and proceeded with the identical routine: the indoctrination of students with what might be called in modern parlance "the party line" of orthodontics on a kind of "until death do us part" briefing level.

These schools then trained the original orthodontists. They had differences of opinion, but upon one thing at least they saw eye to eye. They all realized that the weak link in the orthodontic training program was that in reality it was essentially a vocation and skill with very little scientific background. They agreed that the craft was keyed to orthodontic mechanical devices, and that the kind of teaching being conducted at that time was essentially the briefing of manual routines in the preparation of the student for practice. The student soon sensed, however, that the teachers of the subject were frantically scrambling, thinking, and driving no end to find firm ground on which to create a background more professional than the arts approach for the new specialty. That must have been the spark that inspired the Hellman, Johnson, Oppenheim, and Mershon contributions. This was the major influence that practically shifted the thinking in orthodontics in the short space of a few years from a kind of mortar-and-concrete concept to a "growing things" concept.

The effort to elevate orthodontics to a firm status came about step by step. One subject, then another, was added to the curriculum. Histologists, anatomists, biologists, artists, rhinologists, and even professional photographers appeared on programs and on the various school faculties, and each left some kind of impact upon the thinking. Later came the anthropologists, the pediatricians, and oral surgeons.

That reveals, then, a series of trends that started orthodontics on the way and gave it a great impetus to become the first specialty of dentistry. Notwithstanding all the "brickbats and sneers" hurled at private teaching, these pioneer stalwarts created a specialty, and the universities took over where the trail blazers left off, and they added not only much needed clinical experience to the teaching of orthodontics, but they added much to the background that was needed to lift the specialty to a higher level of prestige and standing.

SYSTEMS

Contemporary with the private school era, there came the custom-made appliances and the so-called systems based on various mechanical routines. The systems were called by various names—Angle, Lukens, Brady, Canning, Knapp, and others. Some of the systems were aided by brochures and textbooks descriptive of and keyed to the particular sytem of appliances. These gadgets, for the most part, were sold by the supply houses, and all the various systems were supported by profuse advertising to stimulate distribution to the dental profession and to urge dentists to get on the new bandwagon.

The appliance promotion lasted for a number of years, until finally it slowly faded out and was replaced (for general practitioner consumption) by the so-called "mail order" system of orthodontics. It would be possible to go on and on and enumerate the many other trends that took the spotlight over the past half century. Suffice it to say, however, that there seems to be little doubt that the combined literature, education, advertising, and teaching of orthodontics over fifty years created a *highly manual-minded specialty* now reflected in much of the publicity that the specialty is receiving in lay and professional press.

RESULT OF THESE TRENDS

Ever since the pioneers fought with tooth and claw over who had the best molar clamp band, or the best gadget to be used in the practice of orthodontics and ever since orthodontic appliance advertising in dental journals spotlighted the nut-and-bolt theme as the basis of orthodontics, the specialty has been featured as craft-minded.

That trend now needs to be seriously re-examined, however, because it is becoming the outstanding identification mark of the specialty. It segregates orthodontists in the public mind into groups devoted to some particular manual or method of treatment, and that is not good for the future of orthodontics, the public, or the dental profession in general.

SCHOOLS OF THOUGHT

Read the recorded literature and you will find conflicting viewpoints that are as opposite as the poles of the earth. Much of this seems to be a result of the indoctrination to which the author has been exposed. Like Indian lore, if you are briefed in one school in your formative years, that is the "party line" you will follow; if by another, then you will adhere to that school, and

so on, whether it is orthodontics, theology, or something else. You will "beat the tom toms" for that which you have been taught with a crusading fervor.

A PLAN FOR COOPERATION

The officers of the Program Committee of the American Association of Orthodontists, in planning the St. Louis meeting of 1952 and the Dallas meeting of 1953, conceived the idea of asking leaders of various popular techniques and schools to appear on the same program, and they had important things in mind. It was thought that this plan would tend to create better understanding, so badly needed for what lies ahead, and offset much intolerance. It was thought that for all to be heard on the same program of the official American Association of Orthodontists is one of the best ways to bring about friendly tolerance, goodwill, and cooperation.

It may be good to remember, in working out such a plan, that if history repeats itself in the second fifty years, many routines of today will be out the window anyway. Therefore, let all be heard today, for tomorrow may be too late. It is understood that the recent meeting of the Pacific Coast Society adopted this same plan and that this idea proved to be a great success and promoted a great deal of harmony and goodwill. Schools of thought, then, are not new; they have been a veritable trademark of orthodontics for about half a century. They inhibit progress, however, if they grow too far apart in basic concepts, become too intolerant of different viewpoints, and begin to look upon each other with "no confidence," and the result is tragic for the long pull. "No confidence" is soon reflected in other health service groups in their attitude toward dentistry's pioneer specialty.

Why are all of these trends or "growing pains" becoming so much more acute and important now than they have ever been before, and why are they so badly in need of careful re-examination since orthodontics has reached maturity?

The latest on federal health service is that the Social Security, health, and education department is now on the cabinet level and under the direction of Mrs. Hobby. The President's Commission, reporting on the health needs of the nation in the section devoted to dentistry, made it plain that dentistry for children should be in the vanguard in health service. Under the new legislation, the FSA disappeared and was replaced by the Department of Health, Education, and Welfare, which could become known in the headlines as HEW in the future.

It therefore would seem that it is not too early to speculate as to what position orthodontics may occupy in anticipated policies ahead. What will be the attitude of the dental profession, the public, and the specialty of orthodontics itself? Everybody is agreed about so-called crippling orthodontic cases such as cleft palate fractures, accidents, and war casualties, but what about all of these thousands of orthodontic cases that do not fall into this category, but constitute 98 per cent of the "run of the mill" cases treated by orthodontists? Much of the answer to that will depend upon what the public and various medical and dental health groups and commissions think about

that orthodontics service per se of the 98 per cent, and just how and where it fits into a health service for all of the people. That decision is obviously something yet to come in the not-too-distant future. Now is the time to build goodwill for orthodontics in public esteem.

For some reason or another, notwithstanding the miraculous advance made in the field of scientific medicine, that profession is now taking the publicity "whiplashing" of its life. The spotlight of bad publicity is being beamed pitilessly, accompanied with no note of gratitude for a fine record of service to mankind. Why has so much heat been generated in this matter? The lay public is almost bound to conjecture uneasily that practices which are to the disadvantage of the patient do exist. Public confidence is priceless to the health services, and must not be ignored.

You may say, "What has all that to do with trends in orthodontics?" I would answer that, by telling you that if we are here to talk about trends, *goodwill* is Trend No. 1 in importance as an influence toward the ultimate destiny of the specialty. To ignore bad publicity is easy, but that does not solve anything for the benefit of the specialty or for the public interest. It seems obvious that some of the campaign directed toward the medical profession may be "splashing over" into the first specialty of dentistry.

Not only does much of this publicity try to reflect orthodontics as a craft, but some of the authors in our own crowd fail to grasp the idea that the literature on orthodontics is read and observed by many readers who are not specialists in orthodontics. Observers who expect to write on any phase of a subject, first scan the official printed record of any scientific subject long before they sit down at the typewriter. They look for the sensational and bizarre and the part that does not make sense, because that theme can be dramatized and makes a good story and no doubt pays off at the "box office."

This observation calls to mind some of our own authors on orthodontics who, in the written record, ask, "What is orthodontics—a health service, a cosmetic service, a luxury service, or something else?" If propaganda and questionnaires now being sent to dental editors from various sources are any criteria, one thing seems certain—orthodontics is attracting more attention from the outside looking in than ever before. Read articles appearing in the dental journals of Australia, England, and various other parts of the world; there can be no mistake that the over-all impression intended for the reader in many of these articles is that orthodontics is a hopelessly confused "problem child" and badly divided on basic concepts.

COOPERATIVE BOOKLETS

Various booklets distributed for parent education by groups, also the brochures distributed to the dental profession by laboratories, unfortunately project the same theme that orthodontic treatment is essentially a manual skill. It is obvious that the writers of such booklets have no intention of making such an impression; notwithstanding, if you ask questions of parents, you will find craft is the impression they get out of the usual booklet written for parent dis-

tribution. The dentist gets this same impression from the impact of booklets sent to him by laboratories, so, all in all, it is a matter of cause and effect that is making the public impact.

CONCLUSION

I would like to say to you that your specialty, in the short space of about thirty-five years, has created the richest, most profuse, and comprehensive scientific written record of any department of dentistry. This record is more complete than many departments of medicine. Notwithstanding that amazing documented record, current publicity in both the lay press and dental journals reveals that the craft department of orthodontics is making the major impact on the minds of writers, the dental and medical professions, as well as the public.

On June 24, 1914, the late Dr. Charles Mayo of the celebrated Mayo Clinic of Rochester, Minn., read a paper before the Section on Stomatology of the American Medical Association at Atlantic City, N. J. In that paper the eminent authority made some interesting observations about dentistry that made headlines in the newspapers. In reference to orthodontics he paid tribute to "the new specialty in dentistry called orthodontia." Dr. Mayo said the subject had more possibilities for benefit to childhood than did any other department of dentistry. He went on to say that the facial improvements made in disfigured children were nothing short of amazing. (He gained this impression from viewing photographs of before-and-after results of the faces of children whose malocclusions had been corrected by some of the workers previous to World War I.) I do not believe that the present generation is going to lose track of one of the most important contributions that orthodontics made to public health service when, after World War I, at Walter Reed Hospital, Major Joe Eby, Colonel Bob Ivy, and Major Hume diverted orthodontic therapy into that amazing contribution to the repair of head and face injuries suffered by the veterans of that war. That techinque should be included in the teaching programs of every university orthodontics course in America. That would contribute much to the field of orthodontics as an important health service, and greatly broaden its base.

As Editor of your JOURNAL, then, if I have a message for you today it is simple and brief. Orthodontics has grown up. It must cease its intolerance, based on mechanical gadgetry, and focus its attention on ways and means to contribute its services to greater numbers of the people, if it is to take its place along with the important departments of the health services.

It must consolidate its position, and all the workers should get "under one tent" if it is to maintain the momentum of prestige that fifty years of hard work by a handful of intrepid and devoted workers created for it.

Do not let orthodontics divide into component parts based on appliance indoctrination. That would put orthodontics back to where it started about the turn of the century.

8015 MARYLAND AVE.

RATIONALE OF MANDIBULAR PROGNATHISM

DAVID MARSHALL, D.D.S., SYRACUSE, N. Y.

ONE of the most misused and misunderstood words in our dental and medical literature is the term *prognathism*. In reviewing the literature, we find that prognathism undergoes variance of meaning, as each author attaches his own interpretation to the term. The misuse of prognathism lies with the misunderstanding of it. If standards can be presented to distinguish between prognathic and normal cases, perhaps then the term would be the same in both dental and medical literature. In endeavoring to present these basic facts which might help clear up the haze concerning prognathism, perhaps a singular definition will result which will be acceptable to scientific literature. *Gnathos* means lower jaw. Prognathism is generally associated with forward projection of the mandible.

In order to understand prognathism, which is an abnormal condition, we must first inquire into and understand the normal condition. Stibbe,[1] in his *An Introduction to Physical Anthropology,* states as follows:

"In man the face is not only relatively small but does not project in front of the cranium. Thus in profile the line of the face is approximately at right angles to the cranium. Or this might be expressed by saying that the face lies under the front part of the cranium. Such a skull is called orthognathous in contrast with the prognathous skull in which the jaws project in front of the cranium. Human skulls are orthognathous or very slightly prognathous."

GLOSSARY OF TERMS

Prosthion.—The prosthion is the lowest point of the gingiva in the median plane between the maxillary central incisors.

Infradental.—The infradental is the highest point on the gingiva in the mandible between the central incisors.

Nasion.—The nasion is the point at the root of the nose that is intersected by the median sagittal plane in the frontonasal suture. The nasion usually lies near the median ends of the lower border of the hairy eyebrows.

Orbitale.—The orbitale is the lowest point in the margin of the orbit that can be felt under the skin.

Frankfort Horizontal Plane.—The Frankfort horizontal plane is a line connecting the inferior border of the orbit (orbitale) and the superior border of the tragus.

Presented as a clinic at the annual meeting of the Northeastern Society of Orthodontists, New York, N. Y., March, 1951.

The following profile x-ray films, taken from my clinical file, illustrate types of prognathism (Fig. 1).

Maxillary prognathism (Fig. 1, *A*) is a condition in which the maxilla does not lie under the front part of the cranium, but lies in front of the cranium as a protruding maxilla. Mandibular prognathism (Fig. 1, *B*) is a condition in which the maxilla lies under the front part of the cranium and the mandible projects in front of the head as an overdeveloped mandible. In bi-maxillary prognathism the maxilla, as well as the mandible, projects in front of the cranium as an overdeveloped maxilla and overdeveloped mandible.

A. *B.* *C.*

Fig. 1.

Physical anthropologists have gone further than merely defining prognathism; they have devised means of correctly measuring prognathism, such as:

1. Facial Angles.—If the facial angle is less than 83 degrees it is prognathous. If the facial angle is between 83 degrees and 90 degrees it is orthognathous. (See Fig. 2.)

2. Line Measurements[3].—Comparison of the length from the anterior margin of the foramen magnum to the nasion with that from the anterior margin of the foramen magnum to the prosthion (Fig. 3). If the distance from the anterior margin to the prosthion is longer in relation to the distance of the anterior margin to the nasion, the skull is prognathous. If the distance from the anterior margin to the prosthion is the same as the distance of the anterior margin to the nasion, the skull is orthognathous.

In reviewing their literature, I find their methods of measurement were confined to the maxilla. However, with the use of roentgenographic cephalometers and other aids, measurements of various angles and plane distances

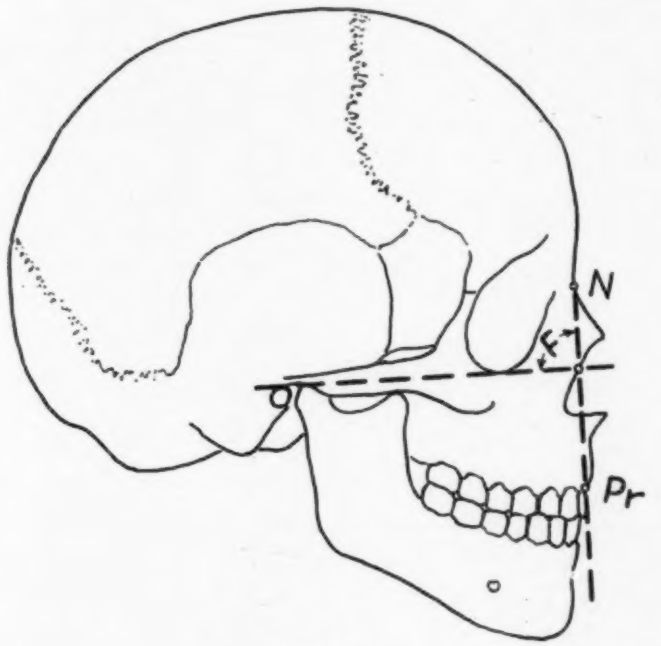

Fig. 2.

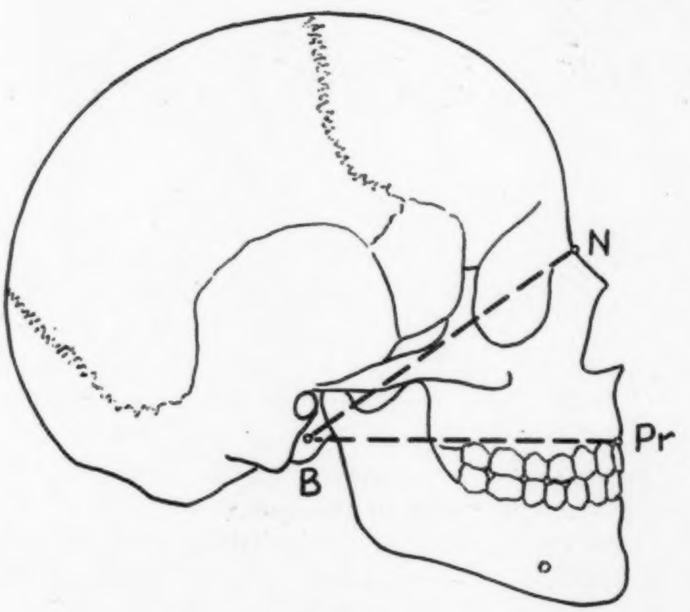

Fig. 3.

of both the maxilla and mandible can be determined. I believe that facial angles and plane distances can be used in determining prognathism of the mandible, as well as of the maxilla. This mandibular prognathism will be illustrated in this article.

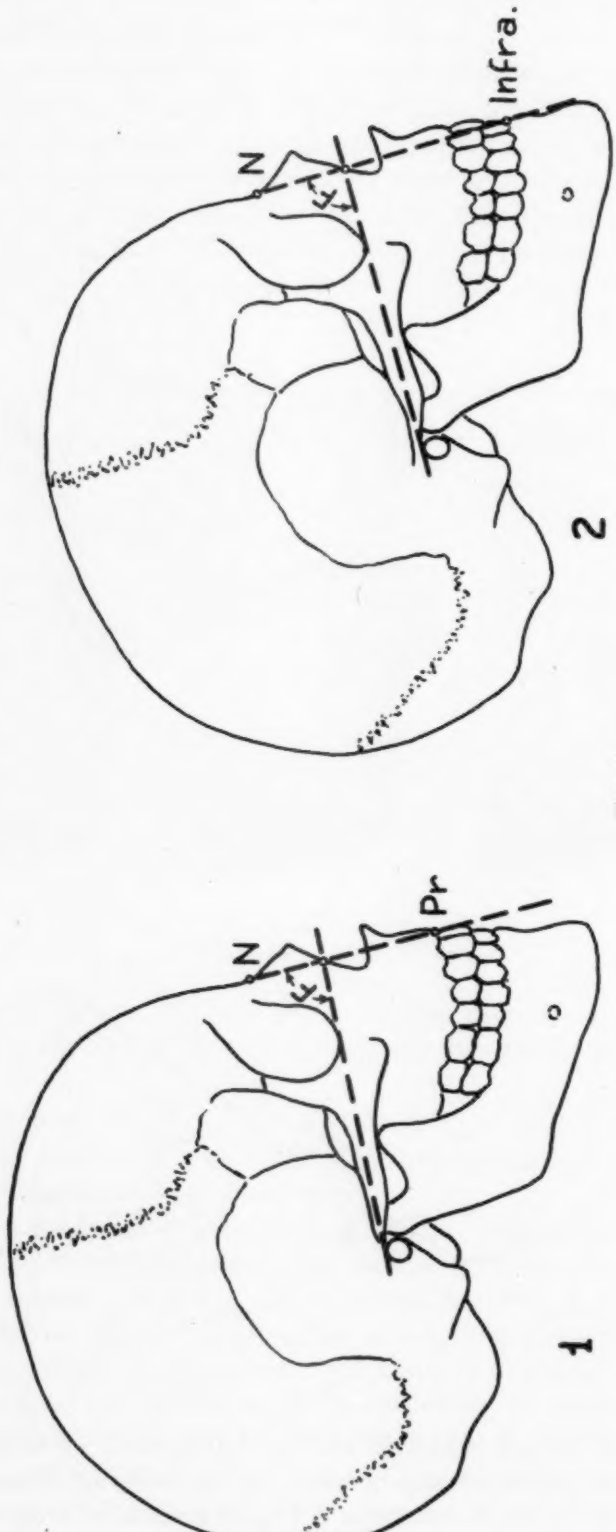

Fig. 4.

There are various ways of measuring prognathism:

A. Facial Angle.—If the facial angle is less than 83 degrees it is prognathous. If the facial angle is between 83 degrees and 90 degrees it is orthognathous.

1. *Maxillary prognathism:* The facial angle formed by the intersection of the Frankfort horizontal plane and the nasion-prosthion plane is a measure of maxillary prognathism.
2. *Mandibular prognathism:* The facial angle formed by the intersection of the Frankfort horizontal plane and the nasion-infradental plane is a measure of mandibular prognathism.
3. *Bi-maxillary prognathism:* The facial angle for the maxilla and the facial angle for the mandible is obtained, and if both are less than 83 degrees it is bi-maxillary prognathism. Both do not have to be the same. The facial angle for the maxilla could be 75 degrees and that of the mandible, 60 degrees.

B. Plane Distances.

1. *Maxillary prognathism:* Compare the length from the anterior margin of the foramen magnum to the nasion (*B-N*) with that from the anterior margin of the foramen magnum to the prosthion (*B-PR*) (Fig. 5, *A*).
2. *Mandibular prognathism:* Compare the length from the anterior margin or the foramen magnum to the nasion (*B-N*) with the length from the anterior margin to the foramen magnum to the infradental (*B-INFRA.*) (Fig. 5, *B*).
3. *Bi-maxillary prognathism:* Obtain the length of *B-PR* and *B-INFRA.* and compare them with *B-N*.

It is evident that the more the face projects, the greater will be the lower measurement as compared with the upper (*B-N*).

The etiology of mandibular prognathism often is very hard to recognize. The causes are of a complex nature involving many factors. The picture is that of an overdeveloped mandible, resulting in disfigurement and lack of balance between the dental organs and the contour of the face. Heredity seems to be the greatest cause of prognathism.

In reviewing the embryology of the head, we find some explanation for this deformity resulting from a faulty development, which is the result of the union of two germ plasmas—the maternal and paternal. The physiology of development is embryology. In the normal development, we see changes in dimensional growth, such as cephalocaudal extent (change in length dimension), dextrosinistral extent (change in width dimension), dorsoventral extent (change in depth), and time (the fourth dimension) functioning simultaneously.

The timing of the union of these processes is very important. If growth occurs in these various dimensions, and the timing is not synchronized, abnormal growth will result.

In order to understand prognathism further, we first must understand the normal pattern of growth and development, as mandibular prognathism

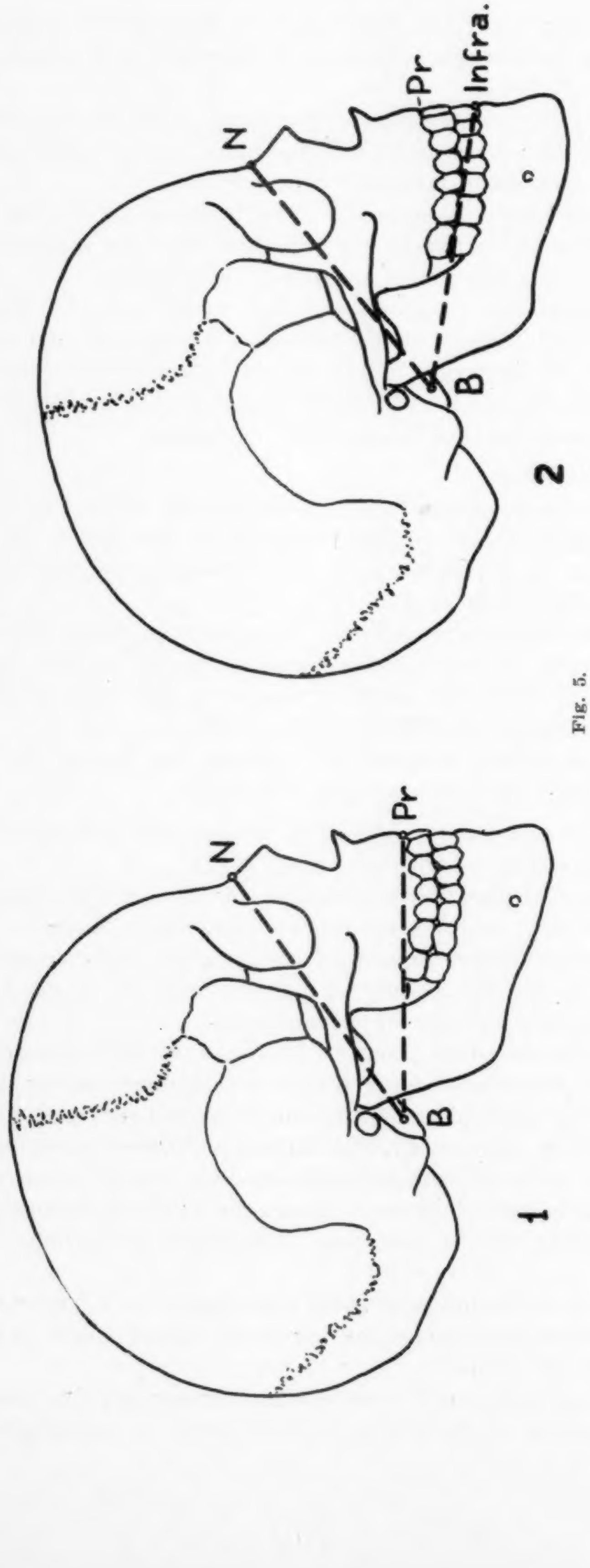

Fig. 5.

is an abnormal growth pattern. In the cycle of development from the embryo to the adult, the anatomic and morphologic facts, combined with their physiologic functions, tend to produce a normal individual. If we find disturbances along these developmental stages, mandibular prognathism may result. Our basic outlines are inherited.

It is true that while we are developing, endocrinal, nutritional, environmental, and many other disturbances may deviate this growth before it reaches its full inherited limits. This may be an over- or understimulation producing changes in dimensions, as well as altering adjustments of various anatomic parts, thus resulting in a prognathic condition. Sometimes our inherited prognathic condition may result in normal relationship due to the aforementioned factors.

In developmental growth of the human body, we must think of: (1) increase in dimensions, (2) changes in proportions, and (3) adjustments to various parts.

The growth of the skull is not different from that of any other part of the body. In the dimensional increase, we have four dimensions—height, width, depth, and time. Biologically speaking, these are called anteroposterior growth, transverse growth, vertical growth, and time. Todd has pointed out that in transverse facial growth, the maximum is reached very early in life. It has been proved that four-fifths of adult growth in the premolar region is reached at 4 years of age. In the intercanine width, the large permanent canines require more space. This is brought about by the anterior maxillary horns, which envelop the premaxillary bones. Here, the greatest width is obtained at about 12 years.

Growth does not occur in defined increments, but in spurts. The dimensional anteroposterior facial growth, basically, is controlled by the deciduous dentition and the development of the permanent molars. The first spurt of anterior growth is the development of the deciduous dentition, which is found during the first six months after birth. The second spurt (between 4 and 7) provides space for the second molar, and the third great spurt (between 15 and 19) provides space for the third molar.

In discussing vertical growth of the face, that is, between the root of the nose and the upper alveolar process, Dr. Todd divided this growth into two components—that above the nasal floor and that below it. Above the nasal floor, the vertical growth occurs in spurts. The first one is six months after birth; the second, during the third and fourth years; another, from ages 7 to 11; and the last, between ages 16 and 19. This growth is largely respiratory in nature. These growth phases seem to correspond to the increase in body volume demanding increase in nasal height. The vertical growth below the nasal floor follows the spurts in the development of the dentition. Time is our fourth dimensional change. If the timing is off, the dimensional growth in height, width, and depth would result in an abnormal growth pattern. The growth of the face, which is settled in the cranium, has a marked relationship to it. Here the face is borne upon the frontal and sphenoid bones. Whenever we have an increase in dimensions in facial growth, we

find increase in cranial growth. This, on the other hand, is related to proportional growth and time. Not only do we have growth by increase in dimension, but growth by adjustment to its cranium.

The cranial growth is related to the vertical growth of the face. Whenever the facial growth is greater than the cranial growth, the face will project increasingly below the cranium. The anteroposterior facial growth is related to the anteroposterior growth of the cranium. If the facial growth exceeds the cranial, there will be a forward projection of the face beyond the cranium. This is known as true prognathism. The anteroposterior and transverse growth is controlled and related to cranial development.

In the extensions of the dental arch, Dr. Todd discusses two loci of special activity, one centering about the canine tooth, and the other about the permanent molars. This latter locus lies directly under the anterior part of the cranium, and it can expand only as much as the anterior extension of the cranium permits, unless there is a readjustment within the maxilla itself. The function differs with the canine locus. Forward extension may take place without cranial growth. The readjustment can occur at the premaxillo-maxillary suture, where growth occurs.

The problem of human facial growth is complicated, first, by its relation to the huge cranial expansion, and second, by the absence of any marked anterior facial growth pattern around the canine. The premaxillo-maxillary suture closes early in life.

During its growth and development, the bones of the skull undergo changes in dimensions, proportions, and adjustments. The mandible, which is the only movable portion, likewise has to undergo these changes. It is remarkable that it does so without other bones influencing it. The growth of the mandible is not interstitial, but by additions on the posterior margins of the ramus and by resorption at its anterior margin. Growth in width is obtained by lateral apposition on the outer plate and resorption on the inner surface. Growth in height is reached by increases at the alveolar border, which grows in an outward, upward, and forward direction, and by addition along the lower border. The growth of the ramus is obtained by additions at its superior surface and at the condyle.

The mandible not only must keep pace with the other bones of the skull, but it also must make the adjustments to secure a normal occlusion. There is a growth area along the junction of the body and the ramus. The ramus becomes resorbed at its internal angle, allowing more room for teeth, and added bone growth takes place on the external border of the ramus, producing a longer mandible.

If there are changes in proportional growth, we may find a normal maxilla with an underdeveloped or overdeveloped mandible; we may have a normal mandible with an underdeveloped or overdeveloped maxilla; or we may have the maxilla and the mandible both underdeveloped or overdeveloped.

CASE REPORTS

The following case histories illustrate what could be done in the treatment of mandibular prognathism. They also illustrate changes in dentofacial relations in prognathic conditions.

Fig. 6.—Case 1.

CASE 1.—A 25-year-old man (Fig. 6) had presented himself for orthodontic treatment. His case history revealed the usual childhood diseases. The patient had been in military service a number of years, and was severely injured, resulting in the loss of his right eye and plastic surgery on his nose.

Clinical examination revealed that the upper left sixth year molar and lower right and lower left second premolars had been extracted previously. The lower right twelfth year molar and third molar were rampant with caries.

After x-ray examination and models were made, the case was diagnosed as a Class III type of malocclusion with an overdeveloped mandible and an underdeveloped maxilla. Most of the maxilla was in linguoversion to the mandible. Bite showed lack of vertical height. The patient was referred to his family dentist before treatment was started and, due to caries exposures, the lower right twelfth year molar was extracted.

Treatment: The mandible was condensed and moved distally with 0.040-inch labial arch wire and 0.036-inch lingual arch wire in the maxilla. This was accomplished with elastic traction. The expansion of the maxilla was brought about by the Johnson twin-arch mechanism, and the anterior region was expanded to such an extent that a space was created between the upper left lateral incisor and canine. A retainer was constructed with teeth to fill the upper left lateral incisor area, as well as the second premolar. Length of primary treatment was fifteen months.

Secondary Treatment: The patient is still wearing the retainer.

The finished case was a compromise, which resulted in a satisfactory change in personality.

CASE 2.—The patient was a 14-year-old boy (Fig. 7). Clinical examination revealed a Class III type of malocclusion. There was a lack of vertical growth and a marked facial deformity due to the patient's mandibular prognathism. With the aid of roentgenograms (full series, lateral plates, and profile) and case history, an underdeveloped maxilla was revealed, with a slightly overdeveloped mandible. In the maxilla there was constriction in the anterior region. The central and lateral incisors were in linguo- and infraversion to the mandibular teeth. The mandible was in mesial relationship to the maxilla. In the maxilla, the anterior teeth were banded from canine to canine, and, with a Johnson twin-arch, anterior growth was established. For anchorage, the sixth year molar was used on the left side and, since the molars were absent on the right side, the second premolar served as an anchor tooth. For lateral growth, a cut-back 0.036-inch Mershon lingual arch was constructed. After normal growth was established in the maxilla, the Johnson appliance was removed and a full lingual arch was constructed.

In the mandible, a 0.040-inch labial arch was used and, with intermaxillary elastics of the Class III type, the distal movement of the mandible was obtained. The normal occlusion was established after eighteen months of active treatment. After normal occlusion was established, vertical height was increased, thereby reducing the facial deformity and bringing about balance between the facial contour and occlusion.

CASE 3.—The patient was a boy, aged 14 years (Fig. 8). After models, case history, and roentgenograms (full series, lateral plates, and profile) were taken, the diagnosis revealed a slightly underdeveloped maxilla with marked constriction in the anterior region. The mandible was in mesial relationship to the maxilla, thus bringing about this Class III type of malocclusion. The mechanical therapy in the maxilla consisted of banding the anterior region from canine to canine. The anterior growth was stimulated by a Johnson twin-arch mechanism. The lateral growth was brought about by a modified 0.036-inch Mershon labial arch with auxiliary springs, 0.020 inch.

In the mandible, the anterior teeth were banded from canine to canine, and a Johnson twin-arch was used. At first, it was used to alleviate the constriction in the mandibular canine areas, as well as to cause depression in the anterior teeth. After this was accomplished, the Johnson arch with coil springs on the molars, in conjunction with the Class III type of elastics, was used. By the use of the elastics and the coil springs, the mandibular molars, as well as the entire arch were moved distally, thereby bringing about a normal dental relationship. By correction of the occlusion, a balanced facial contour was obtained.

Active treatment of this patient lasted eighteen months.

Fig. 7.—Case 2.

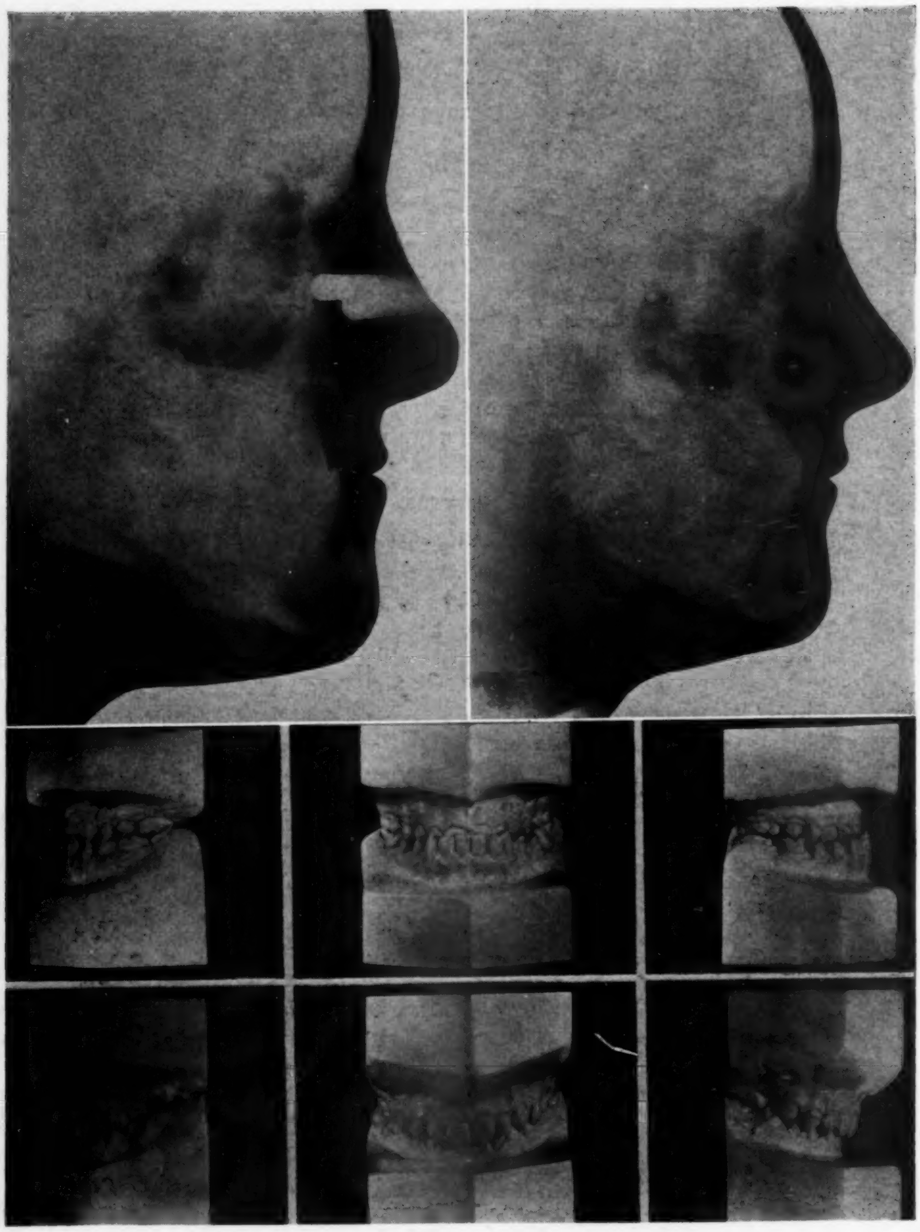

Fig. 8.—Case 3.

Fig. 9.—Case 4.

CASE 4.—The patient, a 23-year-old woman (Fig. 9), presented herself for orthodontic treatment. Aids for diagnosis included casts, roentgenograms (full series, lateral plates, and profile), and a case history of the patient. Diagnosis revealed the mandible had swung to the left side, thereby throwing the mid-point of the face off. The maxilla was underdeveloped and, by articulation, a lack of vertical growth was noted. The upper right central, as well as the entire left, quadrant was in lingual and supraversion to the corresponding mandibular quadrant. The first phase of treatment consisted of normal expansion of the maxilla, as well as establishment of the normal mid-point by repositioning the mandible. The mechanical therapy in the maxilla consisted of banding the anterior teeth and with a Johnson twin-arch to establish normal anterior growth. The upper left lateral growth was established by a cut-back Mershon 0.036-inch lingual arch.

To establish the correct mid-point relationship in the mandible, a 0.040-inch labial arch was constructed and, with Class III type of elastics on the left side, intermaxillary forces attempted to swing the mandible to its correct position. However, after a time, this phase of treatment proved unsuccessful. The next phase of treatment consisted of reducing tooth substance in the mandible, thereby decreasing the anterior diameter. This was brought about by the extraction of the lower left lateral incisor. With a 0.040-inch labial arch, together with its auxiliary springs, 0.018, the lower left areas were brought into normal occlusion, thereby reducing the procumbency of the case, and a normal dental relationship was established. By obtaining normal occlusion, a normal facial relationship resulted.

The patient was under active treatment for two and one-half years.

CASE 5.—The patient was a 30-year-old man (Fig. 10), with a Class III unilateral type malocclusion. The over-all picture revealed a mandibular prognathism with a lack of vertical growth. Further diagnosis, with the aid of roentgenograms (full series, lateral plates, and profile) and case history, revealed in the maxilla a marked constriction in the anterior part with a bunching up of the anterior teeth, blocking out the canines and lateral incisors, which were slightly lingual to the central incisors and canines. There was also constriction in the first premolar area, causing the left premolar to be in linguoversion to the corresponding lower premolars. In the mandible, there was marked constriction in the canine-to-canine area. The anterior teeth were bunched together due to lack of bone. In the maxilla, as well as in the mandible, the anterior region presented itself with too much tooth substance and not enough bone to hold it. In the maxilla, the upper left lateral incisor was extracted to allow sufficient room for normal growth and placement. This was accomplished by banding the anterior teeth and, with a Johnson twin-arch, anterior growth was accomplished. For lateral growth, a modified 0.036-inch Mershon arch was used and, with the aid of its auxiliary springs, 0.018, sufficient lateral growth was obtained.

In the mandible, in order to reduce the tooth substance, the lower right and left lateral incisors were sacrificed. Slight distal movement of the central incisors, as well as the canines, was brought about by means of a 0.040-inch labial arch and its auxiliary springs, 0.018. This reduced the anterior diameter of the mandible, bringing about a good functional bite. By obtaining normal occlusion, the vertical height has been increased, and a balance in the patient's facial contour was reached. The patient was under active treatment for eighteen months.

CASE 6.—An 11-year-old girl (Fig. 11) with severe dentofacial defects consulted me for orthodontic treatment.

Case history revealed that in teething experience several deciduous teeth were removed to make room for permanent teeth. She had the usual childhood illnesses. Tonsils and adenoids had not been removed, removal not indicated.

Clinical examination showed severe dentofacial defects. Condition of dental work was good; no caries was evident. In the maxilla, the upper right second premolar was

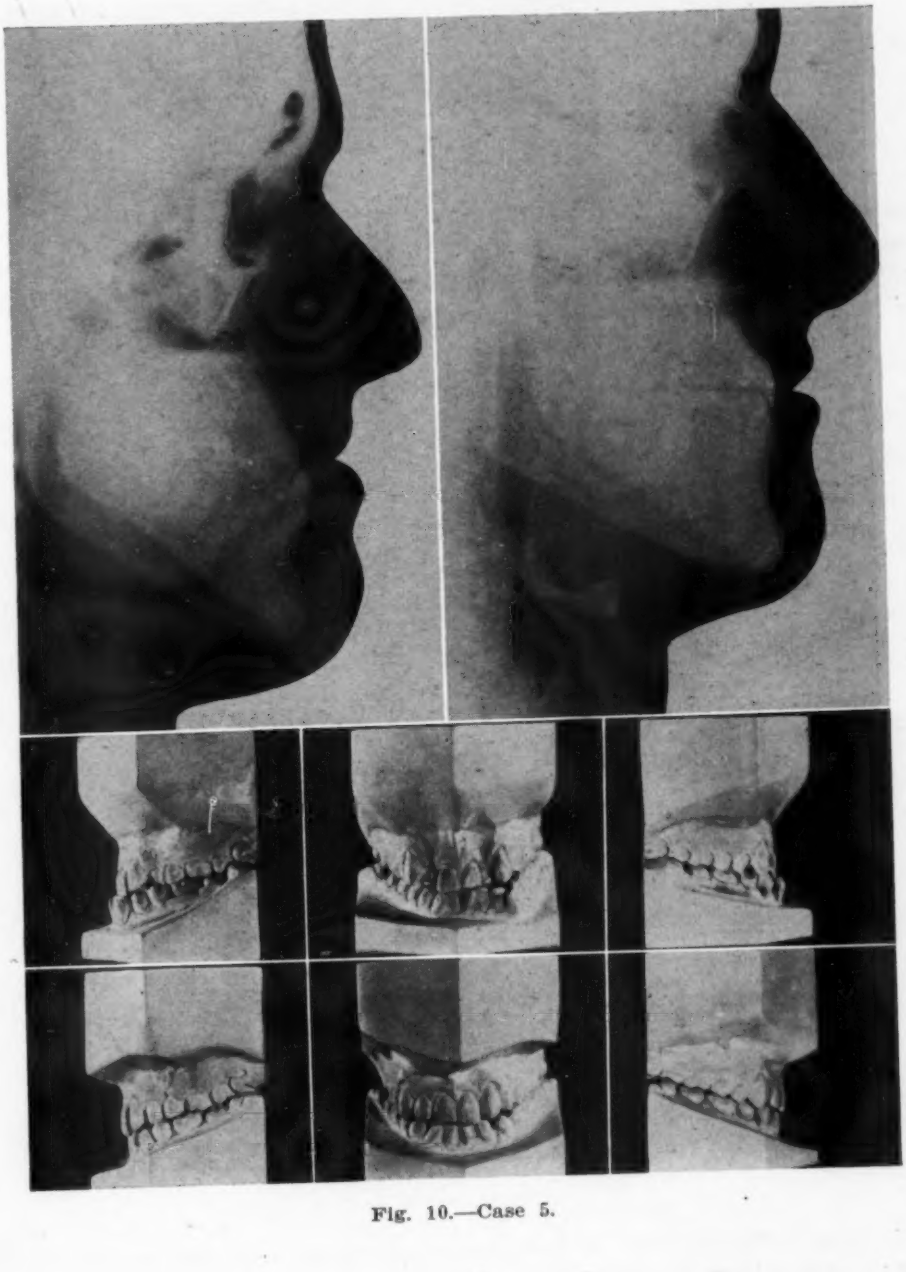

Fig. 10.—Case 5.

about to erupt; in the mandible, the lower left second deciduous molar appeared about to be shed. The lower right second premolar was erupting. Examination showed normal mandible movements, good mouth hygiene, normal palate, tongue ovoid and slightly enlarged, gingival tissue slightly pink, mucous membrane moist and glistening, and saliva

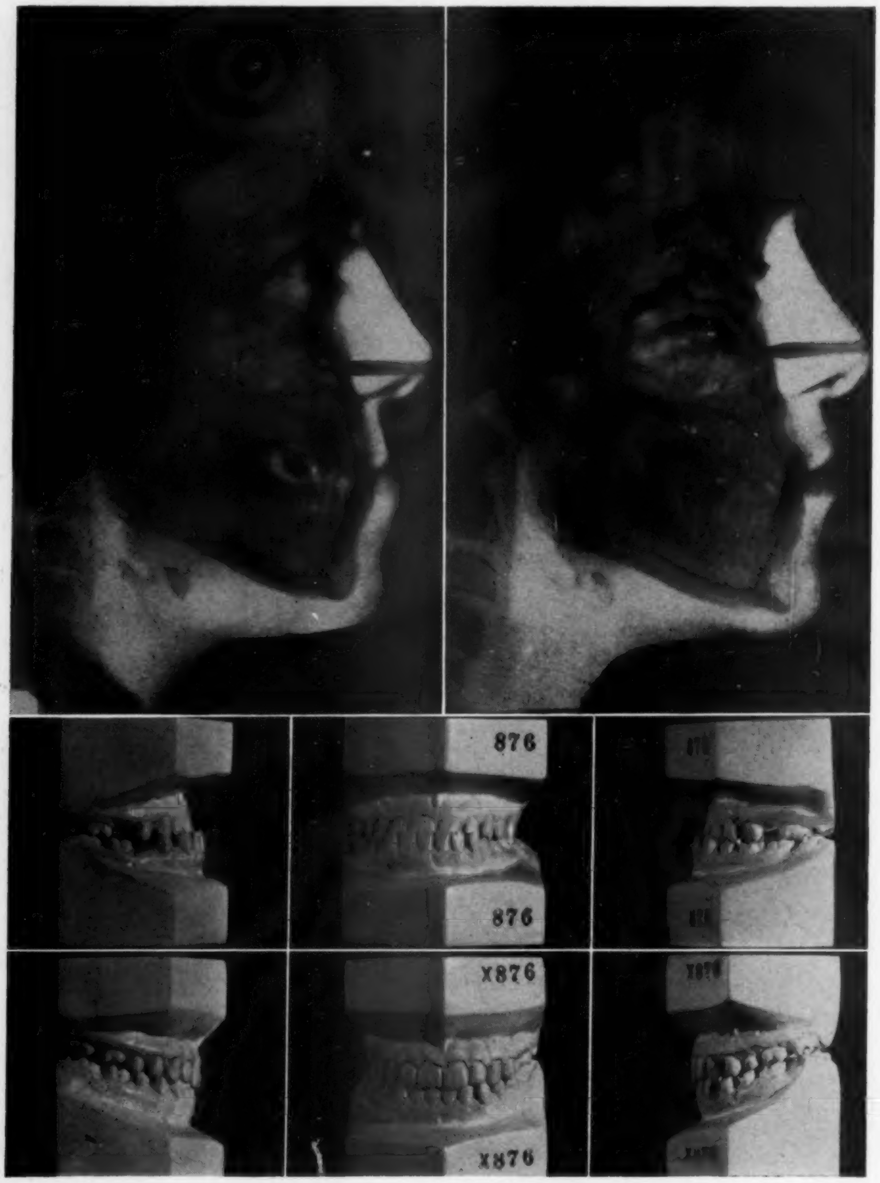

Fig. 11.—Case 6.

ropy in nature. The mid-point of occlusion was off to one side. The patient was found to have a severe Class III malocclusion, with the upper anterior teeth biting lingual to the mandibular arch, which indicates a lack of vertical growth. X-ray films confirm the clinical diagnosis.

Treatment: In the mandible, a 0.040-inch labial arch was used for condensing lower anterior teeth; in the maxilla, a Johnson twin-arch mechanism was used for increasing

intercanine diameter, as well as bringing the anterior teeth forward. With Class III elastics, the mandible was moved distally and the maxilla was moved forward, breaking the bite and thus establishing a normal molar relationship.

The length of time of active treatment was seventeen months. Secondary treatment lasted one year.

CONCLUSION

In prognathism, we have an interference in growth. This interference could be due to changes in dimensions of jaws, changes in proportions, or in their adjustments. Whatever the cause, the result is a disfigurement of the person. There is no set treatment, and each case has to be treated in a compromise fashion, resulting in a balanced proportion. Surgical intervention is not the only answer to this problem; neither is orthodontics. However, I have observed from clinical cases that some correction can be obtained by orthodontic means.

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Medical Arts Bldg.

STONE AGE MAN'S DENTITION

With Reference to Anatomically Correct Occlusion, the Etiology of Malocclusion, and a Technique for Its Treatment

P. R. Begg, D.D.Sc.(Adel.), L.D.S.(Vic.), B.D.Sc.(Melb.),
Adelaide, South Australia

INTRODUCTION

The purpose of this article is, first, to present a concept of anatomically correct occlusion that is at variance with the accepted view of this subject and, second, to outline a technique of orthodontic treatment based on, and justified by, the principles involved in a rational consideration of this correct occlusion and the etiology of malocclusion thus revealed.

The practice of tooth extraction as part of orthodontic treatment is not new; in recent years it has become evident to an increasing number of workers that many cases require extraction of the four first premolars. In particular, C. H. Tweed has described in several articles a technique for this practice which he has so ably developed; but I also extract eight teeth, the four first permanent molars and the four first premolars, in those quite numerous cases having tooth substance markedly excessive in relation to jaw size. However, the basic principles on which extraction of teeth is considered desirable or otherwise have never been clearly described.

Correct occlusion is not a static condition. The relationships of individual teeth in the same arch, the relationships of the teeth of one arch to those of the opposite arch, and the positional relationships of the teeth to the jawbones change continually throughout life. Therefore, the only constant in correct occlusion is continual change.

Correct occlusion is not a fixed or particular anatomic state, but a changing functional process undergoing continual modification and adjustment during the whole life of both deciduous and permanent dentitions.

Two important factors in correct occlusion are the positions of the teeth in the jawbones and the anatomy of the individual teeth.

A factor which is physiologically basic and determines the positions of the teeth in the jawbones is the process of tooth migration. Teeth continually migrate throughout life in two directions: horizontal (mesial migration) and vertical (continual eruption).

The physiologic and biomechanical basis of this process of mesial migration in man never has been satisfactorily explained. With many animals, especially the herbivores, mesial migration of posterior teeth is essential to maintain effective functional occlusion. This process can be seen clearly in the kangaroo, sheep, and elephant.

In the available orthodontic literature, mesial migration of human teeth is regarded as an aberration, a perversion which arises from the so-called anterior component of forces and is considered to play no role other than to produce malocclusion.

On the contrary, it is undoubtedly quite a normal and vitally necessary physiologic process related to, and part of, the process of continual tooth eruption.

Another important factor in the development and maintenance of correct occlusal relationships is the changing anatomy of the teeth. In very few animals does the anatomy of the teeth remain completely unchanged throughout life.

Among the mammals, with perhaps the exception of some of the carnivores, the anatomic forms of the teeth begin to change soon after eruption, because of wear, or attrition, as it is termed. This may not be quite true of teeth with persistent pulps; in these, the tooth form generally does not alter very much, substance loss at the working (occluding) end of the tooth being compensated for at the embedded formative end.

However, in many animals, wear does substantially alter the shape of the crown. This tooth wear takes place both occlusally and interproximally.

Continual loss of tooth substance by attrition is a normal functional process and absence of this loss produces abnormalities. In fact, it would seem, as some writers have stated, that the presence of cusps in the adult human dentition is a retention of juvenile tooth form.

Furthermore, it will be shown that textbook normal occlusion in adults cannot be considered even as the persistence of anatomically correct juvenile occlusion. Rather, it may well be likened to an astigmatic image, a distortion, of correct juvenile occlusion because practically no occlusal and interproximal attrition takes place.

It may be said that for many animals, and man must be included, anatomically correct occlusion is developed and maintained by several basic factors:

1. Tooth movement; continual mesial migration and continual vertical eruption, both of which compensate for tooth attrition.

2. Anatomy of the teeth; the changing anatomy, dependent upon tooth attrition.

Anatomically Correct Occlusion.—It is here maintained that, in civilized man, anatomically correct occlusion is practically nonexistent because the basic factors that make this occlusion possible are absent. To illustrate this and to describe what is here considered anatomically and functionally correct

occlusion, evidence will be presented from a study of aboriginal Australian dentitions. In these it can be seen that the previously described basic factors are present and are essential for the development of a type of dentition and occlusion never seen among civilized groups, namely, anatomically correct or attritional occlusion.

Evidence is available in support of my views, not only on correct occlusion, but also on the etiology of the main mass of malocclusion found in civilized man and on the processes of development of these anomalies.

Furthermore, it can be shown that, while the simple explanation of the evolutionary reduction of jaw size may be sufficient to account for many of the grosser conditions of malocclusion and dentofacial anomalies, evolutionary change does not account for the milder conditions which comprise by far the greater proportion of malocclusions in civilized man.

DEVELOPMENT OF ANATOMICALLY CORRECT ATTRITIONAL OCCLUSION IN AUSTRALIAN ABORIGINALS, AND A COMPARISON WITH TEXTBOOK NORMAL OCCLUSION

Anatomically correct occlusion can develop only when there is sufficient attrition of the teeth for them to assume correct occlusal relationships. This condition is found in Stone Age man (Figs. 1 and 2).

Fig. 1.—Young adult Australian aboriginal's skull showing attrition of the teeth. The upper and lower incisors have established an edge-to-edge bite.

Stone Age man's teeth have occlusal and interproximal attrition, often so marked that dentine is exposed and much worn occlusally, incisally, and interproximally. At a time of life much earlier than may be generally realized, the crowns of his teeth are often worn completely away.

The accepted textbook normal occlusion of civilized man is anatomically incorrect because his food is too soft and concentrated to cause tooth attrition. The incisal, occlusal, interproximal, and axial relations of his teeth remain almost static throughout life because of the firm locking of the unworn cusps in what are erroneously, but almost universally, regarded to be anatomically correct tooth relations.

Also, the almost static positions, especially mesiodistally of civilized man's teeth in relation to his jaws, are not anatomically correct. His jaws are prevented by unworn teeth from assuming correct relations to each other in all directions, but especially in the vertical direction, because they are kept too far apart.

Textbook normal occlusion is incorrect in the same way that most mammals would have malocclusion if their teeth were to remain unworn. For ex-

Fig. 2.—Australian aboriginal's dentition. Tooth attrition has advanced so far that the crown of the lower sixth year molar is worn right off below the cementoenamel junction. The positions of the teeth in the jaws show that there has been considerable mesial migration of all the teeth. There has been much post-mortem bone loss from around the tooth necks.

ample, without extensive attrition of their incisors, rabbits develop severe malocclusion. Also, elephants would develop malocclusion with dire results if the development of their occlusion were hindered by failure of their molars to wear continuously.

High unworn tooth cusps are wrongly considered to have evolved to maintain stability of occlusion throughout life, whereas the only advantage of high cusps is that they help to guide the teeth into their occlusal relationships at the time the teeth are erupting and then to hold them only for a short time after eruption.

Thereafter, unworn tooth cusps prevent the development of continually changing anatomically correct occlusion.

Following is a brief outline of some of the more important aspects of the development of anatomically correct occlusion in Stone Age man, as observed in skulls of Australian aboriginals who died before white man came to Australia. At the same time, some mention is made of the differences between this development of the occlusion in Stone Age man and the occlusion of civilized man.

When Stone Age man's deciduous incisors erupt, his hard, coarse, fibrous, gritty food immediately commences the process of interproximal and occlusal attrition which soon becomes most marked.

In order to make this description of the development of Stone Age man's occlusion more easily understood, it will be mentioned at this stage that, in those instances where anatomically correct occlusion develops, it is a prerequisite that the inherited sizes of all of deciduous and permanent teeth, before they become worn, be greater than can be held by the tooth-bearing parts of the jaw in regular alignment on the centers of the alveolar ridges.

This excess of tooth substance is to compensate for extensive attrition of the teeth. Unless there were excess of tooth substance relative to jaw size, Stone Age man would, early in life, have insufficient tooth substance to occupy fully the tooth-bearing parts of his jaws because tooth attrition is so extensive.

For some time after eruption of the deciduous incisors there is an overbite of these teeth as in civilized man.

As all the deciduous teeth erupt, attrition causes a reduction of the size of each tooth occlusally, incisally, and interproximally. There is maintenance of occlusal contact. There is also maintenance of interproximal contact because all the teeth move mesially around the curve of the arch and remain in proximal contact as tooth wear occurs.

Very soon there is so much wear of the enamel that the dentine is exposed and flat occlusal tooth surfaces are left instead of the original cusps.

As attrition occurs, all the lower teeth move forward relative to the upper teeth so that the upper and lower deciduous incisors gradually assume an edge-to-edge bite.

The change from the initial deciduous incisor overbite to the edge-to-edge bite is gradual and permits all the lower deciduous teeth to move gradually forward relative to the uppers, so that the occlusal relations of the teeth are then such that the distal surface of the lower second deciduous molar is further mesial than the distal surface of the upper second deciduous molar.

All the deciduous teeth, therefore, are in occlusal positions very different from that described in textbooks as normal.

The overjet distally of the upper second deciduous molar helps the sixth year molars to assume correct occlusal relations on eruption, the mesial surface of the lower sixth year molar being mesial to the mesial surface of the upper sixth year molar.

Due to extensive interproximal wear and maintenance of proximal contact of the deciduous teeth, which latter is brought about by the mesial migration of all the teeth, the over-all mesiodistal lengths of the upper and lower deciduous dental arches are reduced. Therefore, the sixth year molars erupt into positions further mesially in the jaws than in civilized man.

The upper and lower sixth year molars in Stone Age man encroach on that part of the upper and lower jaw which is regarded in textbooks as exclusively belonging to the deciduous teeth.

Really, the sixth year molars in Stone Age man assume their anatomically correct positions by erupting partly on what was earlier in life the place for the deciduous molars, whereas in civilized man the sixth year molars are held back too far distally than their truly correct anatomic positions by absence of interproximal attrition of the deciduous teeth.

Angle's classification of malocclusion is for determining the anteroposterior relations of the jaws, and diagnosis is claimed to be aided by observing the occlusal relationships of the sixth year molars after making allowances for drift of these teeth, chiefly mesiodistally, from their correct positions in the jaws, if drift has occurred.

However, in civilized man the sixth year molars are never far enough mesially after eruption, nor are they in their anatomically correct positions in the jaws, except perhaps in those rare cases where all the teeth are so relatively small that they remain spaced, and perhaps also in some cases of caries of the deciduous teeth.

In civilized man the mesial surfaces of the sixth year molars remain unworn so that they cannot continue their anatomically and physiologically correct mesial migration. However, civilized man's sixth year molars do push part of their way mesially and, in pushing, they cause a mesial movement of the deciduous molars and canines.

These first and second deciduous molars with the developing bicuspids beneath them are thus translated so far forward that they prevent the normal spacing of the deciduous incisors. Furthermore, in civilized man there is practically no interproximal wear of the deciduous molars so that there is even further mesial encroachment of the buccal deciduous teeth on the space for the anterior teeth.

Therefore, at this early stage, conditions are being created in civilized man that account for an appreciable amount of the crowding, overlapping, and "double protrusion" of the upper and lower permanent anterior teeth.

From this it can be seen that, even in cases of so-called normal occlusion, the sixth year molars cannot be in their correct anatomic positions in civilized man, even just after eruption, so that their efficacy as diagnostic landmarks for classification of malocclusion is misleading without qualification and allowance for their failure to move mesially to their correct anatomic positions.

Fig. 3, portraying a portion of the lower jaw of an Australian aboriginal child, shows, so early in life, extensive attrition of the mesial surfaces of the lower sixth year molars, which are in contact with the distal surfaces of the second deciduous molars.

This attrition of the mesial surfaces of the sixth year molars allows these teeth to encroach even further mesially onto the parts of the jaws which are, according to the accepted concepts of the development of normal occlusion, regarded as belonging exclusively to the deciduous set of teeth.

Fig. 3 also shows that occlusal attrition of the sixth year molar is already considerable at this early age. Comparing the occlusal surfaces of these sixth year molars with the occlusal surface of the lower right twelfth year molar, which had not erupted, shows how marked the occlusal attrition of the sixth year molars had already become. The comparison shows the extent to which attrition had already obliterated the deep grooves, pits, and fissures.

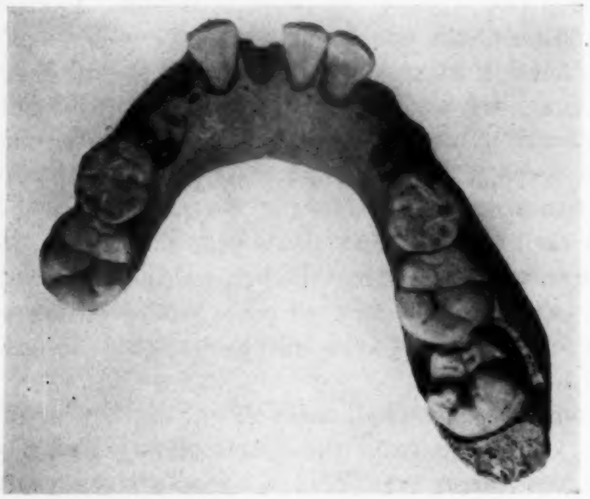

Fig. 3.—Portion of lower jaw of an Australian aboriginal child. The mesial surfaces of the right and left first permanent molars are, so early in life, much worn away where they are in contact with the distal surfaces of the deciduous molars.

In the developing dentition of Stone Age man, as the teeth of the second set erupt and come into occlusion, they begin to wear both occlusally and proximally, so that the earlier-erupting teeth are already considerably worn before the later-erupting teeth come into occlusion and begin to wear.

Therefore, at no stage in either the deciduous or second set of teeth is the occlusion in Stone Age man similar to textbook ideal occlusion.

When the permanent incisors first erupt there is an overbite, just as there is throughout life in civilized man. However, mastication of hard, coarse, fibrous, gritty food soon causes Stone Age man's permanent incisors to wear incisally, at first at an oblique angle. The obliquity of the plane of wear of the incisal edges at first points downward and forward. This obliquity is gradually reduced as the lower incisors move labially, relative to the upper incisors. Ultimately, this plane of wear becomes horizontal and in the same straight line as the flat plane of occlusion of the dentition generally.

T. D. Campbell[1] was the first to show how, in adolescence, the permanent incisor overbite changed to the edge-to-edge bite.

One important result of the attainment of the edge-to-edge incisor bite is that the curve of Spee is not nearly so curved as it is in textbook normal occlusion. It is usually almost a flat plane mesiodistally.

The "cutting" edges of the incisors gradually turn into flat incisal surfaces. The lower incisors move labially and are more procumbent than in textbook normal occlusion, and are not held back too far lingually on the alveolar ridge as they are in textbook normal occlusion.

This does not mean that we should not "upright" the lower incisors in orthodontic treatment because, in any case, orthodontic treatment is a compromise throughout, as we are dealing with a dentition which cannot possibly be made anatomically correct because of lack of attrition.

Also, the upper permanent incisors are not held out too far labially as they are in civilized man's textbook normal occlusion.

During the transition from the incisor overbite to the edge-to-edge bite, the premolars, canines, and twelfth year molars erupt and wear occlusally and interproximally. As the teeth wear interproximally, they maintain contact by mesial migration of all the teeth so that, instead of interproximal point contact, large areas or surfaces of neighboring teeth are touching one another. The amount of space required to accommodate the teeth in each jaw gradually becomes less as interproximal and occlusal attrition proceeds.

In Stone Age man, before the permanent canines erupt, interproximal attrition and maintenance of proximal contact of the teeth bring about a considerable mesiodistal reduction of the total width of the four permanent incisors and of the first and second premolars.

Therefore, the permanent canines have much more space in which to erupt than if this attritional mesiodistal dental arch reduction had not already occurred in the incisor and premolar regions, so that crowding of permanent canines and incisors is avoided.

Also, the twelfth year molars, to some extent even before they erupt fully into occlusion, commence to wear on their mesial surfaces where they come into contact with the distal surfaces of the sixth year molars.

The distal surfaces of the sixth year molars are also worn by rubbing against the mesial surfaces of the twelfth year molars.

Because of this early attritional reduction of the mesiodistal lengths of the first and second permanent molars in Stone Age man, that undesirable overlapping rotation and bimaxillary protrusion of the six anterior permanent upper and lower teeth which would have been inevitable in the absence of attrition is avoided.

Again, this attritional mesiodistal reduction in the over-all lengths of the upper and lower dental arches has already left sufficient spaces at the distal ends of the arches for the unimpeded eruption of the third permanent molars when the time arrives for their eruption. This is because all the erupted teeth, as they wear interproximally, maintain proximal contact by mesial migration.

On the other hand, absence of tooth attrition in civilized man, in those cases which have a similar degree of preponderance of tooth substance over bone substance that would develop anatomically correct occlusion in Stone Age man, produces malocclusion because the delicate balance between tooth size and bone size is not maintained throughout the developmental period of tooth eruption of the dentition.

TABLE I. AVERAGES OF MESIODISTAL WIDTH MEASUREMENTS OF LOWER UNWORN PERMANENT TEETH OF AUSTRALIAN ABORIGINALS

TOOTH (RIGHT OR LEFT PERMANENT)	NUMBER OF TEETH	AVERAGE MESIODISTAL MEASUREMENT (MILLIMETERS)
Central	16	6.06
Lateral	19	6.90
Canine	32	7.72
First premolar	12	7.78
Second premolar	21	7.86
First molar	17	12.87
Second molar	37	12.87
Total		62.06

Further, the eruption of the third permanent molars is prevented or retarded; it is often so retarded and made so difficult by absence of tooth attrition in civilized man that the time quoted in textbooks as being correct for third molar eruption is many years too late. In Stone Age man with anatomically correct attritional occlusion, third permanent molars erupt long before their roots are fully formed, which is in the early teens.

TABLE II. AVERAGES OF MESIODISTAL WIDTH MEASUREMENTS OF TEETH HAVING INTERPROXIMAL ATTRITION TAKEN IN SITU ON NINE AUSTRALIAN ABORIGINAL MANDIBLES AT STAGE OF DEVELOPMENT JUST PRIOR TO ERUPTION OF THIRD PERMANENT MOLARS

TOOTH (RIGHT OR LEFT PERMANENT)	NUMBER OF TEETH	AVERAGE MESIODISTAL MEASUREMENT (MILLIMETERS)
Central	18	5.72
Lateral	18	6.27
Canine	18	7.18
First premolar	18	7.25
Second premolar	18	7.46
First molar	18	10.78
Second molar	18	12.12
Total		56.78

The amount of reduction in size by tooth attrition of the lower dental arch prior to the eruption of the third permanent molars was determined by me in the following way by measurements taken in 1930. At the South Australian Museum, from the large collection of Australian aboriginal skulls and teeth, measurements of all the unworn permanent lower teeth from the central incisor to the second molar were taken with a Boley gauge in millimeters (Tables I and II).

These teeth had fallen out or had been taken from the developmental dental crypts of dried skulls.

The nine mandibles represented in Table II were the only ones at this stage of development in the collection having teeth in regular alignment and in which no teeth were lost.

The difference between the two sets of measurements is 5.28 mm. However, this measurement represents only the reduction on one side of the mandible at this stage. Therefore, even before the eruption of the third permanent molars, the average reduction of length of the whole dental arch from the distal surface of one second molar to the other is 10.56 mm. The amount of mesiodistal attritional dental arch reduction in the maxilla is, at this stage, only about 1 mm. less than in the lower arch. In several of these nine mandibles, the canines, premolars, and twelfth year molars had just erupted into occlusion. For this reason, 10.56 mm. is an underestimation of attritional arch reduction, which occurs at the stage just prior to the eruption of the third permanent molars. Therefore, in order to gain some idea of how much attritional arch reduction occurs up to the time immediately prior to the eruption of the third molar, a mandible at this stage of development was selected. An attempt was made to estimate, from this mandible, the amount of attritional arch reduction. This was done by "restoration" pencil drawings on paper. Each tooth was built out or restored to what was judged to be its full original unworn mesiodistal width. By adding the widths of these "restored" teeth, it was estimated that there was 14.7 mm. attritional arch reduction in this mandible.

This considerable attritional reduction in dental arch length so early in life must prevent the impaction of many third molars, and also it must play a considerable part in preventing malocclusion of the teeth.

By the time the third molars have erupted, the incisor overbite has already disappeared and the edge-to-edge incisor bite is present.

In adolescence, the incisal quarters of the crowns of the upper and lower incisors have worn away.

After the eruption of the full complement of permanent teeth, far more occlusal and interproximal attrition occurs.

The teeth pass through the various stages of attrition which have been described by Broca.

THE FOUR DEGREES OF TOOTH WEAR (BROCA)

First Stage—Enamel worn without cusp obliteration or exposure of dentine.

Second Stage—Cusps worn down and dentine exposed.

Third Stage—A further stage in which quite an appreciable amount of the crown of the tooth is worn away.

Fourth Stage—An extreme stage in which most of the crown has disappeared and the wear has extended to the neck of the tooth.

Not only is the mesiodistal reduction of the dental arch permitted by interproximal attrition, but occlusal and incisal attrition play just as important a part in this reduction of length of the dental arch as a whole.

The greatest mesiodistal diameters of the crowns of unworn teeth are at their contact points close to their occlusal surfaces, and their smallest diameters are at their necks. Therefore, after occlusal attrition extends below these contact points, the greatest reduction in mesiodistal tooth width is due to occlusal and incisal attrition.

As the cusps of the teeth are wearing away and the edge-to-edge incisor bite is becoming established, all of the lower teeth are gradually moving forward relative to the upper teeth so that the molars, premolars, and canines eventually assume typical Angle Class III occlusal relationships. This attritional occlusion is the only anatomically correct occlusion.

Further investigation is necessary to determine whether occlusal attrition or interproximal attrition plays the greater part in dental arch reduction.

Some idea of the great amount of attritional reduction in length of the dental arches may be formed by a comparison of the difference between the total mesiodistal width of all the teeth at their necks and that total at their contact points.

As occlusal attrition occurs, occlusal contact of all the teeth is maintained, without reduction in interalveolar distance, by the hereditary process of continual tooth eruption.

If this process of continual eruption did not occur, that is, if tooth eruption stopped at the neck of each tooth at the level of the cementoenamel junction, our Stone Age ancestors would have worn their teeth right down to the alveolar bone when they were little more than 30 years of age. Their tooth stumps, then, would have been of no further use.

In some Australian aboriginal skulls, attrition has extended so far in the lower sixth year molars that all of the crowns of these teeth have worn away and attrition has continued beyond the bifurcation of their roots. Therefore, what may be likened to two teeth, that is, the mesial and distal roots, existed separately at the time of death instead of the one original sixth year molar.

It is not strictly biologically correct to state that the process of continual tooth eruption has evolved specifically to compensate for tooth attrition. It seems to me that the process of continual tooth eruption is only a particularization of the much more primitive and general process of continual growth of perhaps all surface epithelial structures (for example, fish scales, skin, the gum surrounding the teeth, hair, fingernails, and toenails) to replace loss from frictional wear and tear.

There has been much speculation whether continual vertical tooth eruption is a normal physiologic process or whether it is a manifestation of the pathologic process of pyorrhea. However, observing the development of anatomically correct occlusion, permitted by tooth attrition in Stone Age man,

convinces me that this hereditary process of continual tooth eruption is common to all mankind independently of periodontal disease, and that it was a necessity to compensate for attrition.

Tooth eruption does not stop at the necks of the teeth, but proceeds to the ultimate shedding of the teeth if we live long enough. Continual tooth eruption had such high survival value that, but for this process, our ancestors would not have survived unless they had evolved a much longer tooth. Only continual tooth eruption made extensive occlusal tooth wear possible.

The maintenance of proximal tooth contact, as interproximal wear proceeded, was of course made possible only by the continual mesial migration of the teeth. It seems to me that this continual mesial (horizontal) tooth migration is only a part of the process of continual tooth eruption.

From the foregoing it may be seen that the process of continual tooth eruption is both vertical and horizontal and takes place in these two directions simultaneously so that the resultant direction of eruption is oblique. The vertical part of this process is to compensate for occlusal attrition and the horizontal part is to insure interproximal contact of the teeth by tooth migration as both occlusal and interproximal attrition takes place.

An analogy of this continual tooth eruption is the car of the flying fox or cable suspension car traveling along an obliquely sloping cable; for example, in the upper jaw each tooth may be compared to a car traveling down a cable but remaining vertical as it descends, whereas each lower tooth travels obliquely up a cable.

As a result of this continual mesial tooth migration, which always has taken place in man but which has been hindered by absence of tooth attrition during the relatively short time he has been civilized, tooth positions are not constant or static in their jaw positions throughout life. For example, the anatomically correct position of the sixth year molar is further mesially at the age of 12 years than at 8 years. By late middle age, all the teeth have assumed correct anatomic positions which are so far forward relative to their correct positions early in life that it is difficult to appreciate the extent of this forward migration without seeing Stone Age skulls.

The food of Bronze Age man and early Iron Age man was so relatively refined that they generally had much less tooth attrition than their Late Paleolithic ancestors, to which latter cultural level the Australian aboriginals now belong.

The really anatomically correct occlusion, which only occurs when there is extensive continual occlusal and interproximal attrition, has only one constant quality and that is that it is continually changing throughout life.

On the other hand, textbook normal occlusion, with the teeth almost unworn throughout life, both occlusally and interproximally, and with high interlocking cusps and incisor overbite, is anatomically abnormal; the teeth are prevented by these high cusps from altering their occlusal relations as they should, and are kept from migrating mesially in a proper manner in the jaws. For example, after eruption the sixth year molars remain theoretically in almost the same positions relative to the jaws and relative to the other permanent teeth throughout life.

The unworn cusps are inefficient food masticators compared with the flat-worn occlusal surfaces with dentine exposed and surrounded by a sharp-edged rim of enamel. This sharp enamel edge of the teeth is an efficient shearing instrument for mastication. Also, the retention of tooth cusps and of the incisor overbite in civilized man restricts the masticatory excursions of the mandible.

Many writers (for example, R. H. W. Strang[2] and G. W. Huckaba[3]) refer to the forward migration of the teeth as if it were an abnormal and undesirable phenomenon that causes teeth to move bodily forward and to tip or lean obliquely forward, thus producing malocclusion such as crowding and overlapping of the teeth, especially the anterior teeth, and also causes the condition known as bimaxillary protrusion. These writers consider that this forward migration of the teeth is due to abnormal and perverted muscular forces from the lips, cheeks, tongue, and throat, and also to perversion of axial stress of the teeth during mastication. "Anterior component of forces" is the name used in orthdontic literature to designate the force, from whatever source it is considered to emanate, that causes this undesirable mesial migration of the teeth.

Although mesial tooth migration does produce malocclusions when there is no tooth attrition and when the teeth are very much too large for the jaws, it is, as has already been explained, a normal physiologic phenomenon, vitally necessary for the development and maintenance of anatomically correct attritional occlusion. If this horizontal part of tooth eruption were not to occur, the teeth would have become spaced as they wore.

This mesial migration of the teeth, that is, the horizontal part of the process of tooth eruption, exerts such a powerful force that we sometimes observe, in beautiful examples of textbook normal occlusion, the slow collapse, sometime in adulthood, of this "normal" occlusion to produce progressive crowding and overlapping of the upper and lower anterior teeth. Perhaps this anterior tooth crowding is due partly to the retention of the incisor overbite of adolescence.

When, in senile Australian aboriginal skulls, attrition has left little more than tooth roots, mesial tooth migration is greatly retarded or seems almost to have ceased. We then find no proximal tooth contact; there are spaces between the teeth.

Before the teeth are shed, however, continual vertical eruption seems to occur at a slower rate than tooth wear, so that often very little tooth projects above the bone.

When Australian aboriginal children are reared on our soft food, tooth attrition does not occur and the incidence of malocclusion increases among them.

The relatively low incidence of malocclusion in Stone Age man is very largely due to the reduction by more than half an inch in the total length of each of his dental arches by tooth attrition, so that this lessened amount of tooth substance can be more easily accommodated by his jaws.

Anthropologists, observing the low incidence of tooth irregularity and crowding in primitive man and its high incidence of civilized man, consider that there has been much more evolutionary reduction in the size of civilized man's jaws than of his teeth since Paleolithic times. These observers do not realize that the great attritional tooth reduction appreciably reduced the incidence of tooth crowding of primitive man and that absence of tooth attrition accounts for much of the tooth crowding in civilized man.

As far as I know, reduction of the amount of tooth substance by attrition previously has not been considered in connection with the cause and incidence of irregularity of man's teeth.

A very small minimum amount of function seems to be required to stimulate the jaws to grow to their full hereditary sizes. The well-formed, congenitally edentulous jaws in Sir Norman Bennett's collection support this view. Also, vigorous and prolonged mastication did not prevent the frequent occurrence in Stone Age man of such pronounced tooth crowding and irregularity that marked attrition could not eliminate it.

The usurping by man's hands of much work formerly done by the jaws in his prehuman ancestors has reduced the survival value of the jaws and teeth, so that malocclusion is not now, nor was it in our Stone Age ancestors, so detrimental as to be eliminated by natural selection.

From the foregoing it will be seen that the necessary conditions for the development of anatomically correct occlusion are a slight hereditary quantitative preponderance of total tooth size over jaw size and living on Stone Age man's diet, so that the teeth will wear; whereas, with this same preponderance of tooth substance, man develops tooth crowding when he lives on our refined diet.

As Stone Age man's dental arches were continually reduced throughout life by tooth wear, orthdontists have a well-founded precedent for reducing dental arches by tooth extraction and for discarding the practice of arch expansion while retaining the full complement of teeth.

There are Stone Age individuals, just as there are civilized individuals, who have teeth so small and jaws so big that the teeth remain spaced. In these individuals, continual mesial tooth migration often does not cause proximal tooth contact, but in some of these cases it does cause approximation of some teeth, especially of the molars. There is, however, a greater number of Stone Age individuals than those with spacing, who have such preponderance of tooth size over jaw size that gross crowding develops, regardless of attrition.

For the population at large, whether Stone Age or civilized, the ratio of the amount of tooth substance to bone substance is not constant but tends to fluctuate about a mean value, and the mean value produces a condition of tooth crowding. However, there is a tolerance so that, within certain limits of fluctuation of quantitative preponderance of tooth over bone, anatomically correct occlusion will develop in the presence of attrition.

On the other hand, textbook normal occlusion can develop only when the amount of tooth substance, relative to jaw size, is so small that attrition is not

required to reduce tooth substance. In other words, textbook normal occlusion develops only in those civilized individuals who have too small an amount of tooth substance, if assessed by Stone Age man's requirements which, after all, are evolutionarily the correct quantitative relationships of tooth to bone. This accounts for there being so relatively few civilized people with the full complement of teeth in textbook normal occlusion.

(This article will be continued in future issues of the Journal. References will appear at the end of the article.)

In Memoriam

THOMAS RALPH SWEET*

WITH the passing of Tom Sweet, the profession has lost one of its ablest and devoted members, and the community one of its most respected and valuable citizens. Born in South Dakota, he came to California with his four brothers when he was very young. His father died early in life and very much could be said concerning the most remarkable efforts of his mother who reared her five sons under the most trying circumstances.

After spending two years on the Berkeley campus he transferred to the College of Dentistry in San Francisco where he graduated with the class of 1916. One of his outstanding contributions while he was in college was his work in connection with the founding of an honor society. At the time of his leaving college he became interested in orthodontics and for about a year he was associated with Dr. Ray D. Robinson in Los Angeles. Rejecting a most attractive opportunity, he came to Oakland where he practiced until his death which occurred on November 22.

Soon after his return to Oakland, Tom joined the teaching staff of the University of California where he served with distinction for six years. He was highly esteemed both by students and members of the faculty.

His was a life of interest, not only to himself but to his friends as well. In addition to his great enthusiasm in his chosen profession, he was interested in clocks and model ships, and all that goes on in this world during these perilous times. His model ships are unique in their beauty and are a fine example of his great mechanical skill. It is hoped that some day they may be placed in a museum where they may become a source of pleasure to all who see them.

Visits to the high Sierra were a source of great pleasure to him and he never tired of the beauty of snow-capped mountains and the lovely flowers that grow in the high meadows. An unusual personality and a high degree of intellectual attainment were among his finest possessions. His absence will be felt for a long time by his friends, of whom he had many.

He is survived by his wife, a daughter, two grandchildren and three brothers.

Allen E. Scott.

*Reprinted from the *Pacific Coast Bulletin.*

LOUIS BRAUN

1899-1954

On Tuesday evening, Jan. 19, 1954, Louis Braun died, soon after leaving the meeting of the Angle Society of Orthodontics of which he had been chairman. Educated in dentistry and orthodontics at the University of Michigan, he was honored by membership in O. K. U. and served as Grand Master of the Detroit Chapter of Delta Sigma Delta fraternity.

His professional memberships include the American Dental Association; Michigan State Dental Society; Detroit District Dental Society, of which he was a past president; American Association of Orthodontists, and the Great Lakes Society of Orthodontists, which elected him president for 1954 and which will hold its silver anniversary meeting in Detroit October 31 to November 3.

H. A. Powell Studio

Louis Braun

Dr. Braun was an active member of the Tweed Foundation for Orthodontic Research, a diplomate of the American Board of Orthodontics, and contributed whenever possible to the study and advancement of orthodontics. His quiet ways, pleasant smile, and helping hand will be missed greatly by both his colleagues and his patients.

HOWARD S. MC ELNEA

1905-1954

Howard S. McElnea died at his home in West Orange, N. J., Jan. 2, 1954. Born in Orange, N. J., Dr. McElnea had lived there and in East Orange before moving to West Orange four years ago. After graduation from

Orange High School he attended Washington and Jefferson College and the University of West Virginia, and graduated from the University of Pittsburgh School of Dentistry in 1931.

Dr. McElnea entered practice in East Orange in 1931, interrupting his career to serve five years as a captain in the Army Dental Corps. He decided to specialize in orthodontics and completed the postgraduate course at Columbia University. He was associated with Dr. William Giblin of Montclair, N. J., until Dec. 1, 1953, and had just been practicing in Williamsport, Pa.

His professional organizations included local, state, and national dental societies; the Middle Atlantic and American Associations of Orthodontics; West Essex Dental Society; Associated Physicians of Montclair and Vicinity; and the East Orange Lodge of Masons.

He is survived by his wife, Mrs. Iona Bigleman McElnea, a son, H. Stanley McElnea, Jr., a daughter, Brenda McElnea, and a sister, Mrs. George Tully of Worcester, Mass.

William Giblin.

Department of Orthodontic Abstracts and Reviews

Edited by

Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

The Occurrence of Torus Palatinus and Torus Mandibularis in 2,478 Dental Patients: By Steve Kolas, Victor Halperin, Kenneth Jefferis, Samuel Huddleston, and Hamilton B. G. Robinson. Reprinted (with deletions) from *Oral Surg., Oral Med., and Oral Path.* **6**: 1134-1141, September, 1953.

The percentage occurrence of both palatine and mandibular tori varies considerably with racial (e.g., Caucasian, Mongoloid, and Negroid) groups. This study reports findings on a large Caucasian group and a relatively small Negroid element. Torus palatinus may be defined as exostosis along the suture line of the hard palate. Torus mandibularis may be defined as an exostosis, unilaterally or bilaterally, situated on the lingual aspect of the mandible above the mylohyoid line in the region of the premolars.

The generally accepted views of the causes of tori are genetic background, functional response, and, for the palatine tori only, continued growth process.

Thoma classified torus palatinus as (a) flat, (b) spindle, (c) nodular, and (d) lobulated.

Mandibular tori generally exist as smooth, rounded bony protuberances, or exostoses, which vary in size and number, and occur chiefly in the premolar region of the lingual aspect of the mandible. They occur unilaterally and bilaterally. These tori were classified as: (a) single unilateral torus, (b) multiple unilateral tori, (c) single bilateral tori, and (d) multiple bilateral tori.

This study was made on patients reporting to the clinic of the College of Dentistry of the Ohio State University. Twenty-four hundred seventy-eight consecutive patients were screened for routine dental treatment. The presence, or absence, of tori, largely detected by visual examination, was recorded for each patient. In the infrequent cases of doubt digital palpation was used. The tori were classified according to morphology. Size was not particularly stressed. Patients in all age groups were included in the study.

Of the 2,478 subjects examined 519 (20.9 per cent) possessed torus palatinus. The 1,193 males had 175 tori palatinus (14.7 per cent) and the 1,272 females had 340 (26.7 per cent). This approximate 2 to 1 ratio favoring the female is significant. On the other hand, racial distribution study reveals 21.7 per cent of 2,064 whites manifesting palatine tori and 16.2 per cent of 407 nonwhites (95 per cent Negro) possessing this type of torus. The relatively small number of non-whites examined (407) reduces the significance of this difference to a level of unimportance.

The percentage occurrence of torus palatinus increases from the first to the third decade of life (13.7 to 23.9). The percentage of torus palatinus in the decades beyond this level off, indicating the onset of a plateau before the

age of 30. The percentages for the seventh and eighth decades are given for comparison but are probably not accurate estimates, due to the small numbers observed in these groups.

The most frequently observed type was the flat tori (10.4 per cent) with the spindle type being second (7.5 per cent). The lobular and nodular tori occurred much less frequently. It is well to note that the flat and spindle tori together comprise approximately 84 per cent of the total palatine tori observed.

Of the 2,478 subjects observed, 192 (7.75 per cent) possessed mandibular tori of one type or another. There was practically no difference in frequency between the male (7.90) per cent and female (7.70 per cent). Similarly, there is an insignificant difference in the percentages between the white (7.90 per cent) and non-white (7.37 per cent) groups.

Mandibular tori were observed very infrequently (1.48 per cent) in the first decade but by the third decade rate of frequency had increased to 10.6 per cent. In those decades subsequent to the third decade, only a slight difference in the percentages of occurrence exists and thus a comparative plateau or "leveling off" phenomenon manifests itself. The percentage for the eighth decade is inserted merely for comparison but is probably not an accurate estimate due to the small numbers observed in this group. This lack of continued increase of frequency in the decades beyond 30 years of age is indicative that mandibular tori usually have their onset by 30 years of age.

News and Notes

The American Association of Orthodontists Fiftieth Annual Session

Plans are now complete for what promises to be the most successful meeting in the history of the American Association of Orthodontists. This will be the fiftieth annual session of the organization. The meeting will be held at the Palmer House in Chicago from Sunday, May 16, 1954, through Thursday, May 20, 1954.

The facilities of the Palmer House are ideal for this meeting. You will not want to miss it. Reservations should be made now directly with the hotel.

All nonmembers wishing to attend must write, at least thirty days before the session, to the Chairman of the Credentials Committee, Dr. Frederick B. Lehman, 1126 Merchants Bank Bldg., Cedar Rapids, Iowa.

The following is a condensation of the official program of the fiftieth annual session of the American Association of Orthodontists, which will be held May 16 through May 20, 1954, at the Palmer House, in Chicago, Ill.

Preliminary Program

MONDAY, MAY 17

9:15 Invocation. Rev. Edward J. Mullaly, Chicago, Ill.
Address of Welcome. Allan G. Brodie, Dean of the University of Illinois College of Dentistry, Chicago, Ill.
Response. President-elect Frederick T. West, San Francisco, Calif.

9:45 A Simple Technique Showing the Mesial or Distal Movement of the Maxillary Molars. Joseph E. Johnson, Louisville, Ky.

11:15 Relation of Orthodontic Disturbances to Masticatory Function. R. S. Manly, Boston, Mass.

12:15 Golden Anniversary Luncheon. Charles R. Baker, presiding.

2:15 Symposium on the Temporomandibular Joints. John R. Thompson, Chicago, Ill., Moderator.

1. Anatomy and Growth of the Joints. Harry Sicher, M.D., Chicago, Ill.
2. The Relation of Orthodontic Treatment to the Joints. William S. Brandhorst, St. Louis, Mo.
3. Influence of Growth of the Joints on Orthodontic Therapy. Robert W. Donovan, Chicago, Ill.
4. Abnormal Function of the Joints. Robert M. Ricketts, Pacific Palisades, Calif.

4:30 Presentation of the Albert H. Ketcham Memorial Award to Charles R. Baker. Raymond L. Webster, President, American Board of Orthodontics.
Acceptance by Charles R. Baker.

6:30 Stag Dinner. William A. Murray, Presiding.

Tuesday, May 18

9:30 Facial Growth and Its Clinical Importance in Orthodontics. Alton W. Moore, Seattle, Wash.

10:30 Prize Essay.

11:15 The Effect of High Kilovoltage on Hard and Soft Tissue Definition in Lateral Cephalometric Roentgenograms. J. B. Franklin, Milwaukee, Wis.

12:15 The International Luncheon, Andrew Francis Jackson, presiding, honoring:
Oren A. Oliver, Nashville, Tenn., President, Federation Dentaire Internationale.
Harold Hillenbrand, Chicago, Ill., Secretary, American Dental Association.
Mr. Nathaniel Leverone, Chicago Rotarian, nationally known speaker, philosopher, and wit, will deliver an address.

2:15 A Radiographic Cephalometric Study of Changes Associated With Orthodontic Treatment of Selected Cases of Malocclusion Using Upper Appliance With Occipital Anchorage. Waldo O. Urban, Evanston, Ill.

3:15 Own Your Own Office as a Paying Investment. Investments for Orthodontists. Retirement in Orthodontics in Ten Years. Everett Hunt and Vernon L. Hunt, Eureka, Calif.

4:30 Business Meeting.

Wednesday, May 19

9:30 Selective Grinding, An Integral Part of Orthodontic Therapy. Albert C. Heimlich, Santa Barbara, Calif.

10:30 Ways of Appraising Modern Methods of Analysis in Terms of Common Office Experiences and Observations. J. William Adams, Indianapolis, Ind.

11:30 Orthodontic Specialization Within the British National Health Service. Alexis W. Eastwood, London, England.

12:15 Past Presidents' Luncheon. Brooks Bell, presiding.

6:30 President's Reception and Banquet Honoring Dr. and Mrs. James W. Ford.

7:30 Banquet, entertainment, and dancing in the Grand Ballroom of the Palmer House. Music by Jimmy Richards and his orchestra.

Wednesday Afternoon

general clinics

2:00 to 5:00 p.m.

The research meeting will be in progress at the same time as the general clinics.

1. Orthodontic Diagnosis at the University of Iowa. Orthodontic graduate students, University of Iowa.
2. Orthodontic Therapy With the Edgewise Mechanism. Northwestern University student demonstration by

Francis J. Furlong
Glenn E. Jackson
George S. Kendrick
Milford Franks
Nils A. Nordh
Sheldon W. Rosenstein
Leonard Schlossberg
Gene S. Trausch
Alexander Wildman.

3. Critical Analysis of Orthodontic Failures. Louis Tinthoff, Peoria, Ill.
4. Cases Long Out of Retention. Arthur B. Lewis, Dayton, Ohio.
5. Reduction of Forces in Class II Treatment by Elimination of En Masse Movement—Edgewise. Howard N. Delbridge, Beloit, Wis.

6. Color Photography. A. C. Heimlich, Santa Barbara, Calif.
7. Preformed Double Loop and Sectional Edgewise Arches. Arthur V. Greenstein, New York, N. Y.
8. Early Treatment. Richard E. Barnes, Cleveland, Ohio.
9. Ten Years With the Face Bow and Extra Oral Anchorage. What It Will Do and What It Won't Do. Its Proper Application When Its Use Is Indicated. Sidney Asher, Chicago, Ill.
10. Retraction of Cuspids and Incisors Where Bicuspids Have Been Removed. Edgar T. Haynes, Indianapolis, Ind.
11. Cold Cure Acrylic Retainers. Max R. Kadesky, Dubuque, Iowa.
12. Cephalometric Radiography. A Motion Picture Presentation Illustrating a Simple Technic as a Routine Diagnostic Aid in Practice. M. Allen Weingart, New York, N. Y.
13. A Simplified Photographic Procedure. Lowell T. Oldham, Mason City, Iowa.
14. Toothbrushing Alcove. Cecil G. Muller, Omaha, Neb.
15. Hi Lo Lingual Arch Use in Cases Requiring Extraction of First Bicuspids. Lyman Wagers, Lexington, Ky.
16. Looking Ahead in Orthodontic Treatment. Milton Rabine, Cleveland, Ohio.
17. A Method of Cephalometric Analysis of Class II, Division 1 Case Treated by Conventional Method. Albert Miller, Kansas City, Mo.
18. A Method of Registering Changes Accomplished in Class II. Leo W. Mastorakos.
19. A Method of Starting Retraction of Mandibular Cuspids in Extraction Cases. Walter W. Winter, Decatur, Ill.
20. Technique in Construction of Plastic Models for Teaching Purposes. George S. Uchiyama, St. Louis, Mo.
21. Rubber Dam Auxiliary for Open-Bite and Habit Cases. Paul V. Ponitz, Battle Creek, Mich.
22. The Application of the Deciduous Polygon as an Aid in the Diagnosis and Treatment of Deciduous Malocclusions. Frank Hapak.
23. Line of Reasoning and Method That Aids Materially the Use of Extractoral Anchorage. William Adams and Samuel Goldsman, Indianapolis, Ind.
24. Practice Management. Vernon L. Hunt and Everett Hunt, Eureka, Calif.

THURSDAY, MAY 20

9:30 A Panel on the Treatment of the Deciduous and Mixed Dentition.

Leuman M. Waugh, Moderator, New York, N. Y.
George W. Hahn, Berkeley, Calif.
S. J. Kloehn, Appleton, Wis.
H. K. Terry, Miami, Fla.

MONDAY, MAY 17 THROUGH THURSDAY, MAY 20

AN EXHIBIT OF CASE REPORTS BY TWENTY OF THE THIRTY-FIVE DIPLOMATES CERTIFIED BY THE AMERICAN BOARD OF ORTHODONTISTS AT THE 1953 EXAMINATION

Richard E. Barnes, Cleveland, Ohio
Maurice C. Berman, Chicago, Ill.
Allen C. Brader, Allentown, Pa.
Eli S. Brody, New York, N. Y.
Irving Buchin, Forest Hill, N. Y.
David L. England, Santa Barbara, Calif.
Donald A. Closson, Kansas City, Mo.
Eugene H. Farber, Beverly Hills, Calif.

Grant B. Hatfield, Jr., Kansas City, Mo.
Herbert D. Jaynes, Atlanta, Ga.
Irving Kraut, Trenton, N. J.
George R. McCulloch, Yakima, Wash.
Stanley J. Krygier, Wilmington, Del.
John S. Rathbone, Santa Barbara, Calif.
Milton Siegal, Albany, N. Y.
Noel J. Tromlin, Jr., Dallas, Texas
Waldo O. Urban, Evanston, Ill.
Kenneth M. Walley, Vancouver, B. C., Canada
Everett H. Watkins, Eureka, Calif.
Tom M. Williams, Dallas, Texas

Commercial Exhibits

A representative group of twenty-five manufacturers and dealers specializing in orthodontic supplies will be in continuous session throughout the meeting in the exhibition hall on the fourth floor.

Registration

The registration desk will be open Sunday at the entrance to the exhibition hall on the fourth floor of the Palmer House. Register early and plan to attend the opening buffet Sunday evening at 6:30 in the Grand Ballroom.

Social Events

SUNDAY, MAY 16

6:30 Informal Buffet Dinner.

MONDAY, MAY 17

12:15 Golden Anniversary Luncheon. Charles R. Baker, Presiding.
6:00 Stag Dinner. William A. Murray, Presiding.

TUESDAY, MAY 18

12:15 International Luncheon. Andrew Francis Jackson, Presiding.

WEDNESDAY, MAY 19

12:15 Past Presidents' Luncheon. Brooks Bell, Presiding.

Ladies' Program

Harland L. New, CHAIRMAN

CO-CHAIRMEN

Ione J. K. Kral — A. Florence Lilley — Beulah G. Nelson

HOSTESSES

Mrs. James W. Ford
Mrs. Frederick T. West
Mrs. George M. Anderson
Mrs. Franklin A. Squires
Mrs. G. Hewett Williams
Mrs. Ralph G. Bengston
Mrs. Sidney Asher
Mrs. B. F. Dewel
Mrs. Abraham Goldstein
Mrs. Leonard Grimson
Mrs. William A. Murray
Mrs. Harland L. New
Mrs. Richard A. Smith
Mrs. Howard E. Strange
Mrs. Frederick T. Barich
Mrs. Reuben L. Blake
Mrs. Allan G. Brodie
Mrs. William B. Downs
Mrs. William F. Ford
Mrs. John R. Thompson
Mrs. Robert L. Williams

SUNDAY, MAY 16

6:30 Informal Buffet Supper, Grand Ballroom.

MONDAY, MAY 17

9:00-11:00 Continental Breakfast (complimentary).
2:45 Merchandise Mart Tour.
6:30 Cocktail Party and Buffet Dinner.
Entertainment by Miss Sulie Harand, Singing Dramatist in "Wonderful Town."

TUESDAY, MAY 18

9:00-11:00 Continental Breakfast (complimentary).
12:00 Luncheon and Fashion Show. Empire Room, Palmer House.
Afternoon free for shopping, movies, and broadcasts.

WEDNESDAY, MAY 19

9:00-11:00 Continental Breakfast (complimentary).
2:30 Tour of Mrs. James Ward Thorne's Miniature Rooms, Art Institute, Michigan Avenue at Adams Street.
6:30 President's Reception. Cocktails, dinner dance, and entertainment. Grand Ballroom.

Rules Governing Visitors

To insure full participation of all members, it is necessary to limit the attendance to members of the American Association of Orthodontists and to the following:

A. No attendance fee:
1. Full-time teachers in university dental schools.
2. Full-time graduate or postgraduate students in university orthodontic departments.
3. Dentists from outside Canada or the United States who are members of recognized dental or orthodontic organizations.

B. Attendance fee $10.00:
1. Associate or junior members of constituent societies of the American Association of Orthodontists.
2. Associates (in practice) of members of the American Association of Orthodontists.

C. Attendance fee $20.00:
1. Recent graduates of university orthodontic departments who are not members of constituent societies of the American Association of Orthodontists.
2. Other guests certified by the credentials committee.

University of North Carolina

The University of North Carolina, School of Dentistry, announces its graduate program in orthodontics, oral surgery, and pedodontics, leading to a Master's Degree or a certificate. The graduate programs in orthodontics and pedodontics require fifteen months in residence, while twenty-four months are required in oral surgery.

For further information please write the Dean, School of Dentistry, University of North Carolina, Chapel Hill, N. C.

American Association for Cleft Palate Rehabilitation

The annual meeting of the American Association for Cleft Palate Rehabilitation will be held at the Webster Hall Hotel in Pittsburgh, Pa., Friday and Saturday, May 14 and 15,

1954. The program will include special sectional meetings in the areas of medical-surgical problems, dental-prosthetic-orthodontic problems, and speech-psychology-education-social work. Motion pictures and special exhibits relating to cleft palate rehabilitation will be shown throughout the convention. The meeting will be open to any individual with an interest in cleft palate rehabilitation.

Further information about the program may be obtained from Dr. S. M. Dupertuis, 3700 Fifth Ave., Pittsburgh, Pa.

Notes of Interest

John R. Clark, D.M.D., announces the opening of his practice, limited to orthodontics, in association with Earle L. Miller, D.D.S., at 351 College Ave., Elmira, N. Y.

John R. Earman, D.D.S., M.S.D., and Kenneth K. Shephard, D.D.S., B.S., wish to announce their association in the practice of orthodontics in the Comeau Bldg., West Palm Beach, Fla., and 117 North Fifth St., Ft. Pierce, Fla.

Robert S. Freeman, D.D.S., M.S.D., announces his return to the Medical Center Bldg., 3705 East Colfax, Denver 6, Colo., practice limited to orthodontics.

Dr. Robert B. Hedges announces the removal of his offices to West Ave. at Cedar St., Jenkintown, Pa., and the association of Dr. Robert L. Blaney, practice limited to orthodontics.

Edward W. Hodgson, D.D.S., announces the removal of his office to 3731 Goodfellow, St. Louis 20, Mo., practice limited to orthodontics.

Dr. Joe M. Pike announces discontinuance of his practice in Minneapolis to devote full time to his office at 503 Granite Exchange Bldg., St. Cloud, Minn., practice limited to orthodontics.

Abraham Silverstein, D.D.S., announces the opening of his new office at 2070 Grand Concourse, Bronx 57, N. Y., practice limited to orthodontics.

Glenn H. Whitson, D.D.S., 80 Hanson Pl., Brooklyn, N. Y., announces the opening of an additional office on Interlaken Rd., Route 112, Lakeville, Conn., practice limited to orthodontics.

OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

American Association of Orthodontists

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President, Leigh C. Fairbank - - - - - - - - - 1726 Eye St., N.W., Washington, D. C.
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